AN MAP PUBLICATION 95p

SPACE Voyager

FEATURING:

PATRICK MOORE
THE CHILLY PLANETS

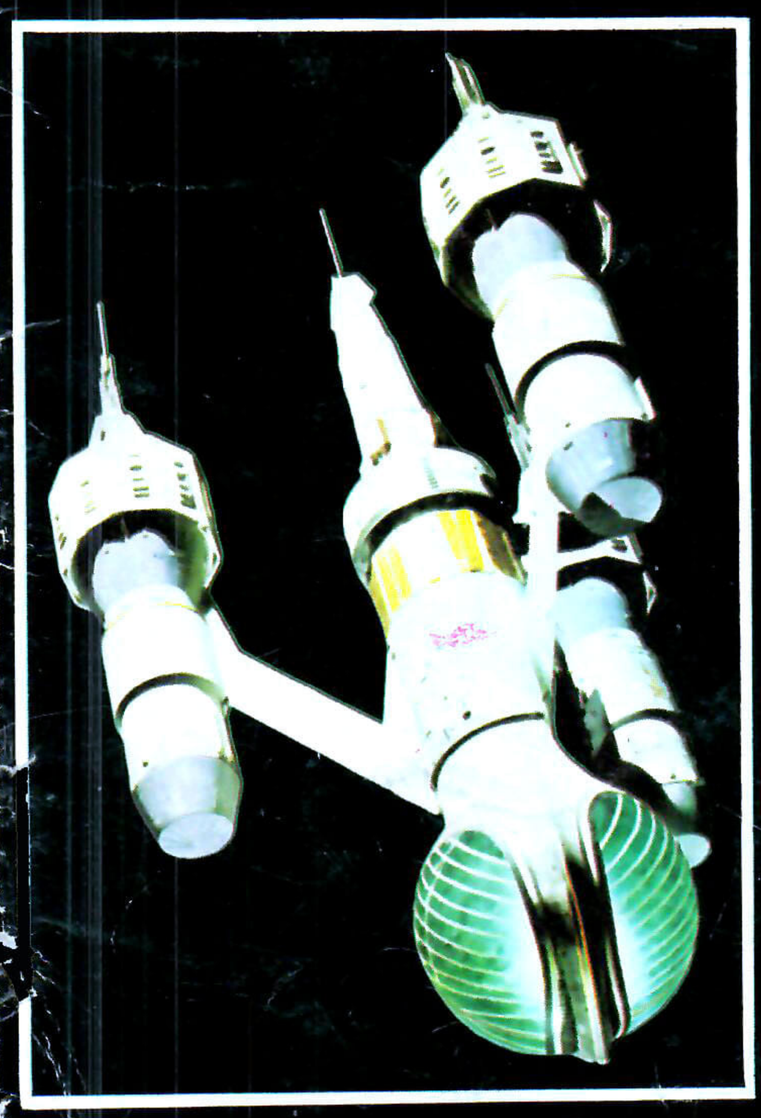
VOYAGER 1 & 2
THE STORY SO FAR

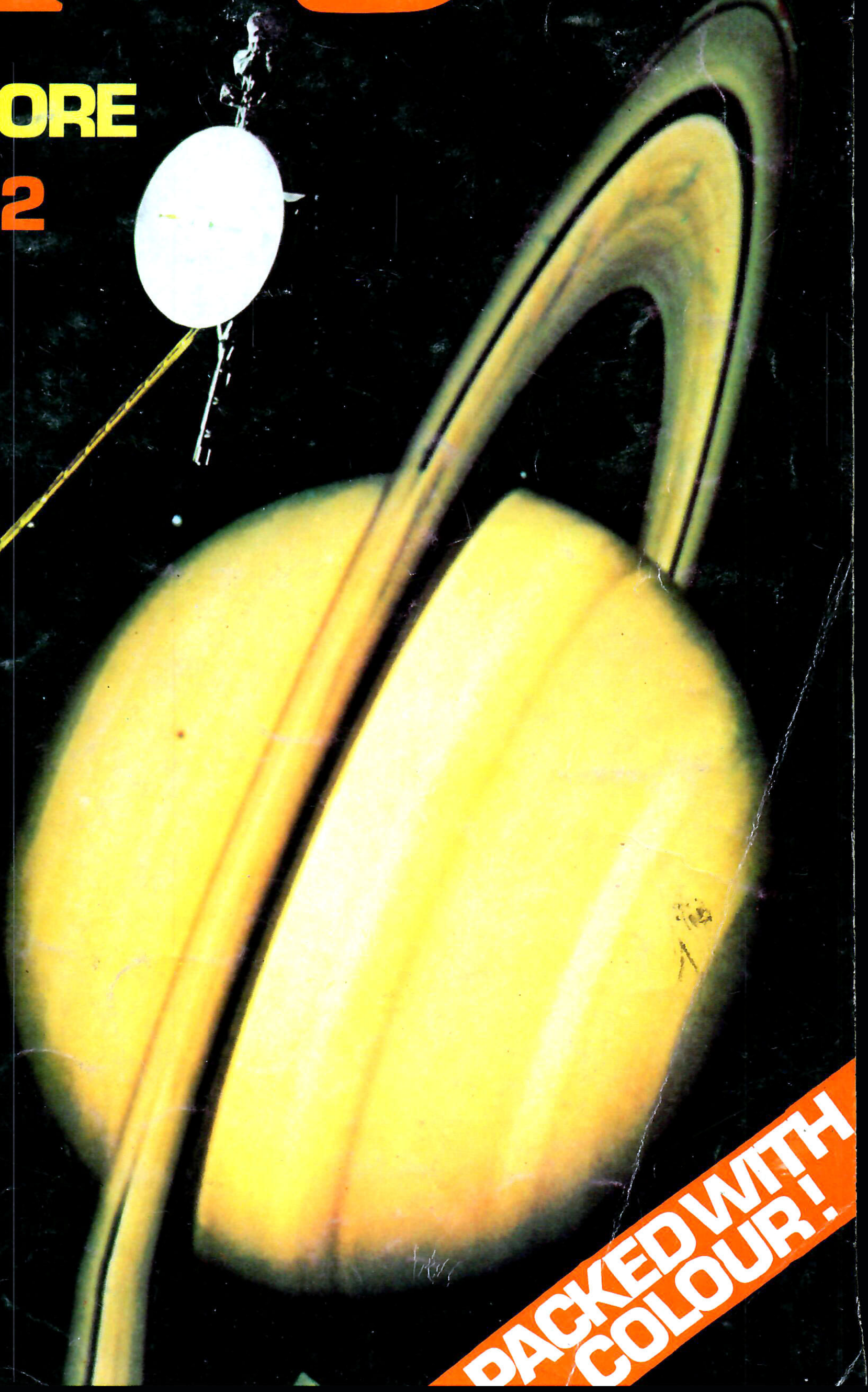
FANTASY
AN INTRO. TO GAMING

DAEDALUS
B.I.S. SPACE PROJECT

S-F STORY
MAN OUT OF TIME

BLAKE'S 7
THE LIBERATOR





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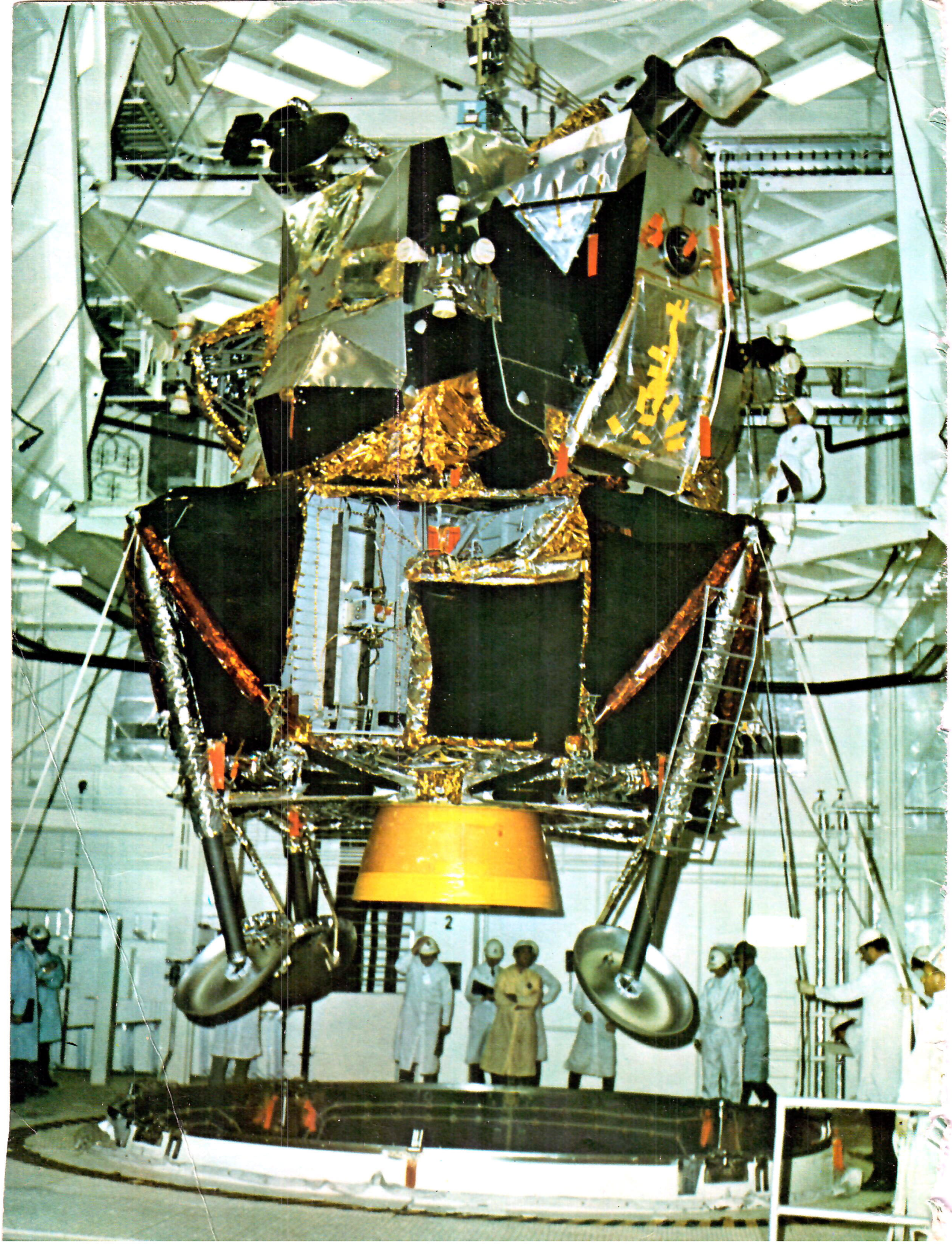

SPACE Voyager

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CONTENTS

CAPTAIN'S LOG – Message from the editors	6
DATA-BANK – Space fact and fantasy news	7
SHUTTLE NEWS – Orbiter updates	8
BATHTUBS ON THE MOON – Russia's Lunokhod	10
FANTASY ROLE PLAYING – An introduction	12
X-15 – America's rocket plane	16
PROJECT DAEDALUS – BIS space project	18
THE CHILLY PLANETS – Patrick Moore investigates	22
JOURNAL OF THE WHILLS V – Star Wars '2'	26
SPACE SHUTTLE – The dream becomes reality	30
BLAKE'S 7 – Exclusive drawing and photos	34
PRODUCTS – New kits and pieces	38
LANDSPEEDER – Model project	42
SOUNDS – Round-up of good listening	44
SKY IN WINTER – Watch the sky with Patrick Moore	46
CHRISTMAS ROUND UP – Current crop of SF/Fantasy films	47
RINGS AROUND THE EARTH – TV/Video satellites	50
VOYAGER – The story so far	54
1982 CALENDAR	58
ALIEN – Build a monster!	60
SPACE MODEL SURVEY – The full list of model kits	63
MAN OUT OF TIME – SF short story	66
READ OUT – Books for space fans	78

ON THE COVER
What could be more appropriate? NASA's Voyager passes the planet Saturn on its journey through our Solar System and beyond. Inset, the *Liberator* from the Blake's 7 TV series.

Opposite, the Apollo 10 Lunar Module (LEM) is lowered into the 'nose' of the Saturn V Rocket in 1969. On this flight, astronauts Eugene Cernan, Thomas Stafford and John Young were to try out the LEM in Lunar skies for the first time.
Photo: NASA

Inside Back Cover
The incredible Cygnus Spaceship from 'The Black Hole' sails serenely through the Cosmos.
Photo: ©Walt Disney Productions

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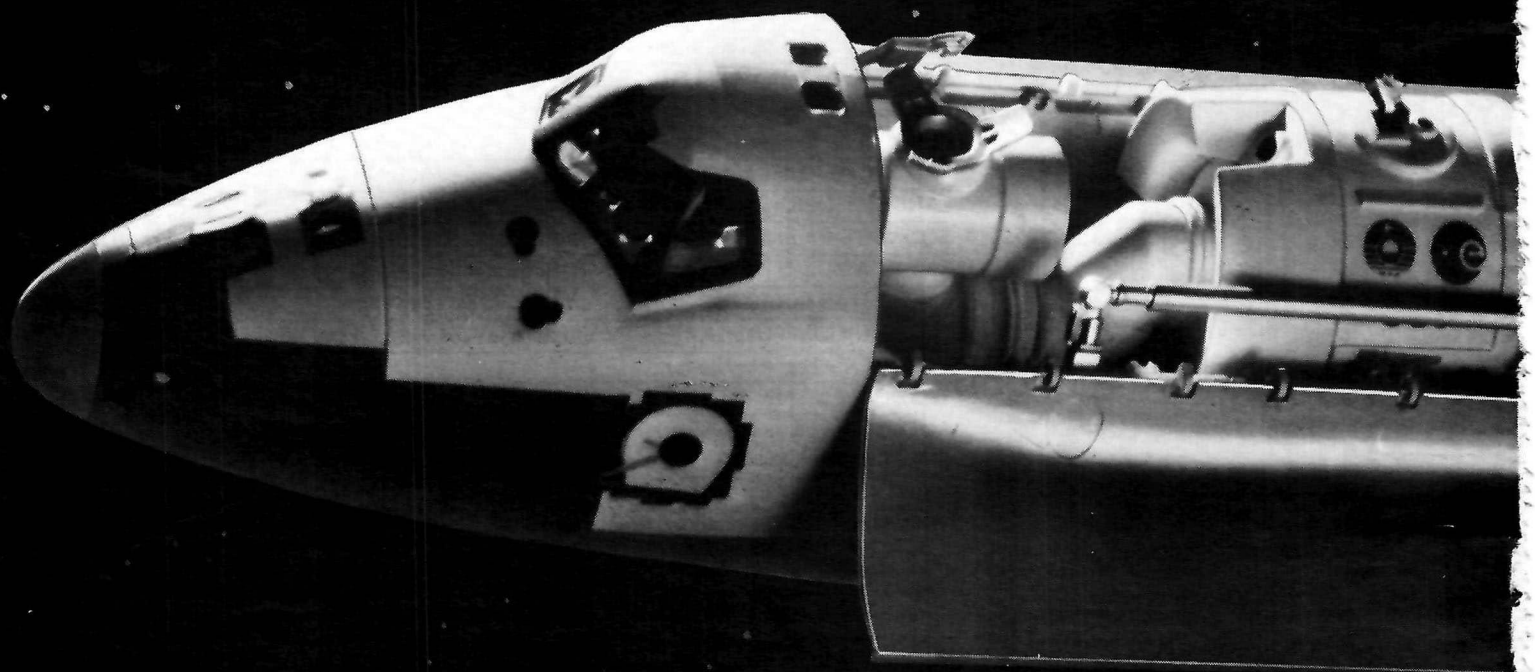

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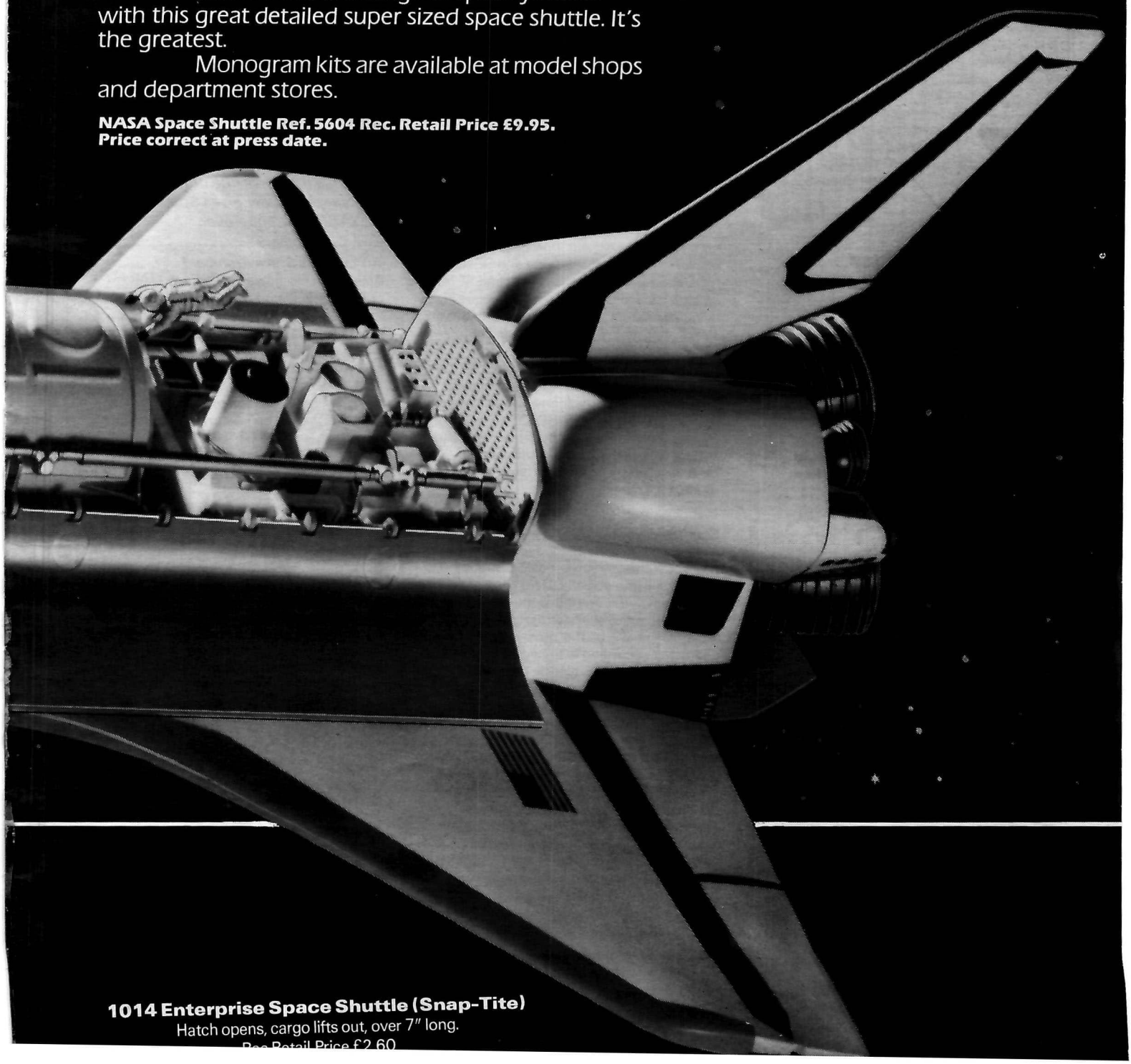

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CAPTAIN'S LOG

A new venture

It all began a couple of years ago. An idea that had lain dormant for a long time; an idea that was formulated further in a West End cinema during several long and less-than-exciting portions of the *Star Trek* film press review. Further stimulation was provided after emerging into the bright sunlight and pausing at a newsagent's window. Here was a display chock-full of Science Fiction and Fantasy glossies, special movie 'tie-ins', adventure comics and the more 'hard core' literature like *OMNI* and *Astronomy.* What, then, if you combined the best attributes of these exciting titles into one ambitious magazine? Just suppose the fans of TV and cinema SF features, the fantasy and role-playing gamers, the modellers of rockets and robots, readers of SF, amateur astronomers and just interested casual enthusiasts were to find all their pet subjects between a single set of covers. It was a fascinating, not to mention challenging, prospect and at long last the idea has now been realised in **Space VOYAGER.**

We've tried hard to make this publication as visual as possible; as exciting and attractive as possible. We think we've succeeded but the proof of the pudding is whether you, the reader, share our views. Within the following pages we bring you an exciting world of science fiction and fact welded together by a team of internationally-known authors, each a specialist in their own very specialist fields. We count ourselves particularly priviledged to carry leading features by Patrick Moore, Alan Bond and Alan McKenzie, together with other equally authoritative, writers and artists, including David A Hardy.

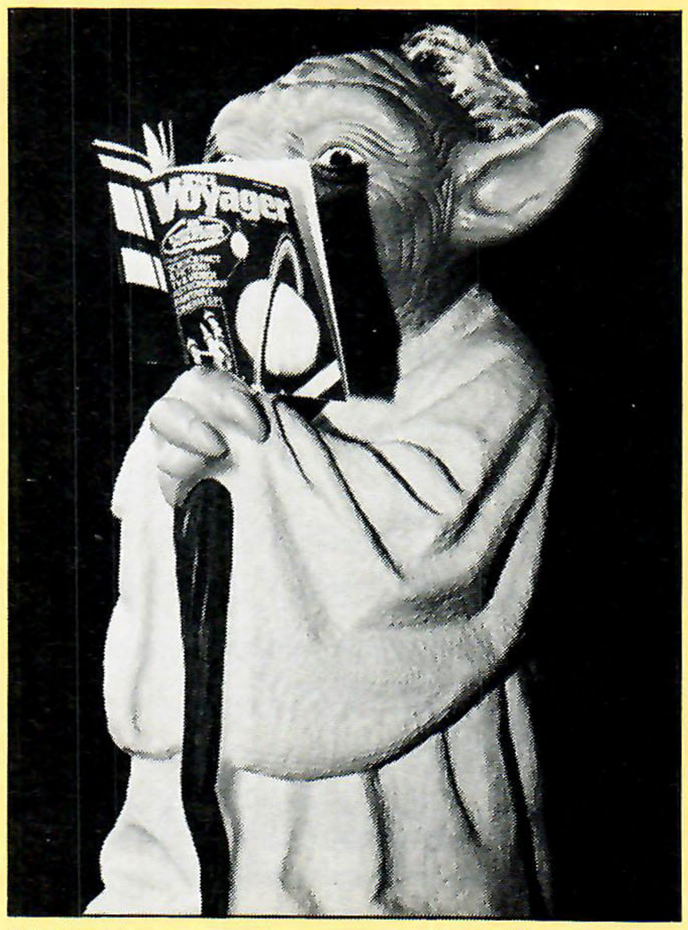
If Space VOYAGER proves a huge success, as we confidently predict, then plans will be formulated for the magazine to appear on a regular basis, perhaps as a quarterly publication. So, here it is: A wealth of publishing and design experience brings a galaxy of contemporary talent to inspire the imagination and excite the interest. Don't be afraid to let us have your opinion of the result; your likes, dislikes, favourite features and suggestions for others; maybe we'll be publishing *your* thoughts in the next issue. Watch this space . . .

Managing Editor is *Ray Rimell*

Editor of SCALE MODELS since 1976, Ray Rimell is an experienced modeller, having just about built at least one example of every type of subject going (in all materials); he has contributed chapters to several modelling books and also authored two historical aviation tomes currently under production. By no means does he consider himself an 'SF expert' but is an unashamed fan of the genrè and from the outset was determined that Space VOYAGER was to be MAP's biggest, brightest and most ambitious publishing venture ever.

Technical Editor is *Mat Irvine, AFBIS*

Mat's lectures at the 1981 and 1982 ME Exhibitions in the Wembley Conference Centre on TV Special Effects and related subjects, have proved overwhelmingly popular. Well known to readers of *Starburst* and SCALE MODELS for his space hardware and SF model articles, record/book reviews, as visual effects designer Mat also frequently crops up on BBC TV programme credits and has also regularly appeared on *Swap Shop.* With a deep knowledge in all areas of the subject, Mat was the obvious candidate to act in a technical capacity to control the many, varied features planned for Space VOYAGER and cajoling the writers, illustrators and photo agencies into parting with their precious material. His specialist knowledge makes him a key member of the team.



'Adventure, excitement – A Jedi craves not these things; on the other hand . . .' A very special reader gives Space VOYAGER the once-over.

Art Editor is *Steve Archibald*

Apart from his official capacity as MAP drawing office/studio manager, Steve has also been responsible for designing the covers of most MAP magazines and 'Extras', a task which is quite alarming in its proportion. (Just count how many titles there are and multiply by 12!) As airbrush artist and magazine layout designer, Steve has few peers. As a reviewer/modeller, he will competently tackle subjects as diverse as WW2 German warplanes, dinosaurs, military figures and modern sports cars with equal skill; despite every effort, we've not caught him out yet!

IMAGES

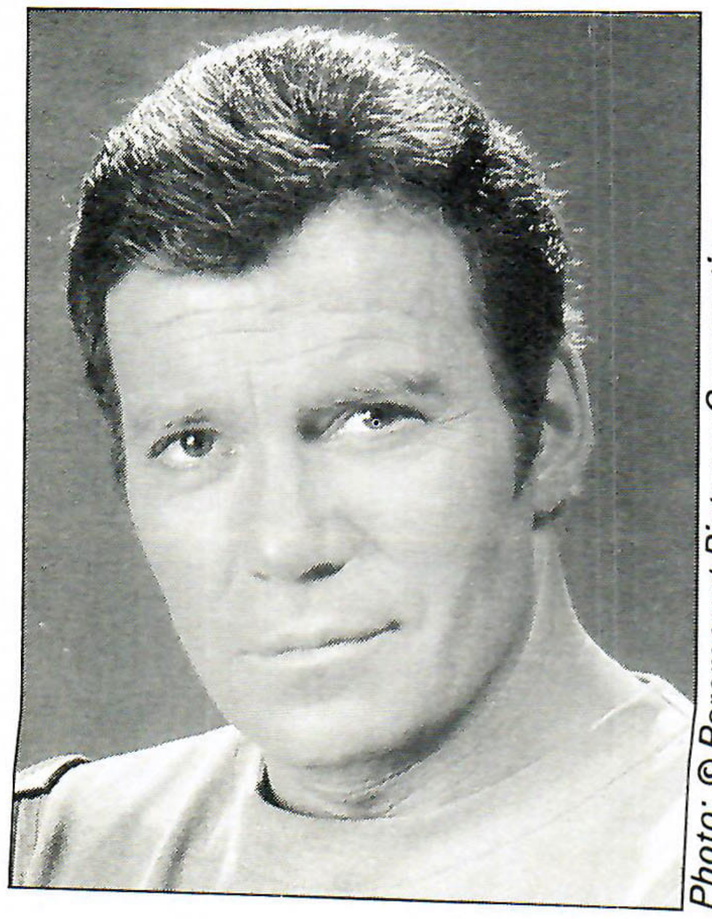


Photo: © Paramount Pictures Corporation

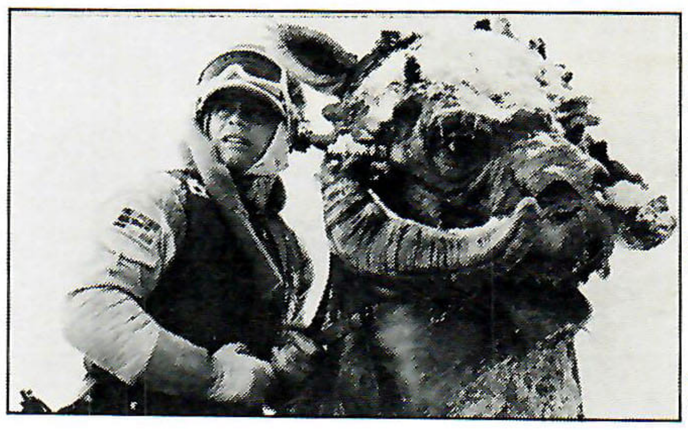
Star Trek lives!

As production of the second *Star Trek* movie proceeds with the subject of Mr. Spock's demise still unresolved, at least one of the major stars is committed to the project. One William Shatner, *alter ego* of Admiral James Tiberius Kirk, will be the 'most pivotal character' according to the new film's director Nicholas Meyer. If he is to be believed, the story will concentrate more on the characters and plot than with gimmicks and going overboard with SFX. Indeed, the budget figure is 'only' a reported £10 million as opposed to around £40 million for the first production.

If Meyer has his way, Trekkies the World over will breathe a sigh of relief hoping, as we do, that the new film will reflect the character and spirit of the original TV series. Whether Spock is killed off, as actor Leonard Nimoy wishes, remains to be seen; Paramount have already been besieged by fans begging a reprieve for the popular Vulcan.

Return of the Jedi

Latest news from Twentieth Century Fox is that the original *Star Wars* movie, now subtitled 'Episode IV A New Hope', is to be re-released this August. Not too far behind, in the Spring of 1983, is the re-release of *The Empire Strikes Back,* together with a trailer for *Revenge of the Jedi* and *that* has a projected Summer 1983 premiere. We hope to be around to provide the latest news of the third epic which will again boast Lawrence Kasdan as screenplay writer. According to a recent interview with the American *Starlog* magazine, Kasdan promises that Jedi's 'basic thrust' will complete the trilogy and fans can assume that the new film's structure will be similar to *Star Wars* and *Empire;* cutting back and forth. All of the familiar characters will appear and several new ones will be introduced. We look forward to the results . . .



© Lucas Film Ltd., (LFL)

DATA BANK

And then there was one

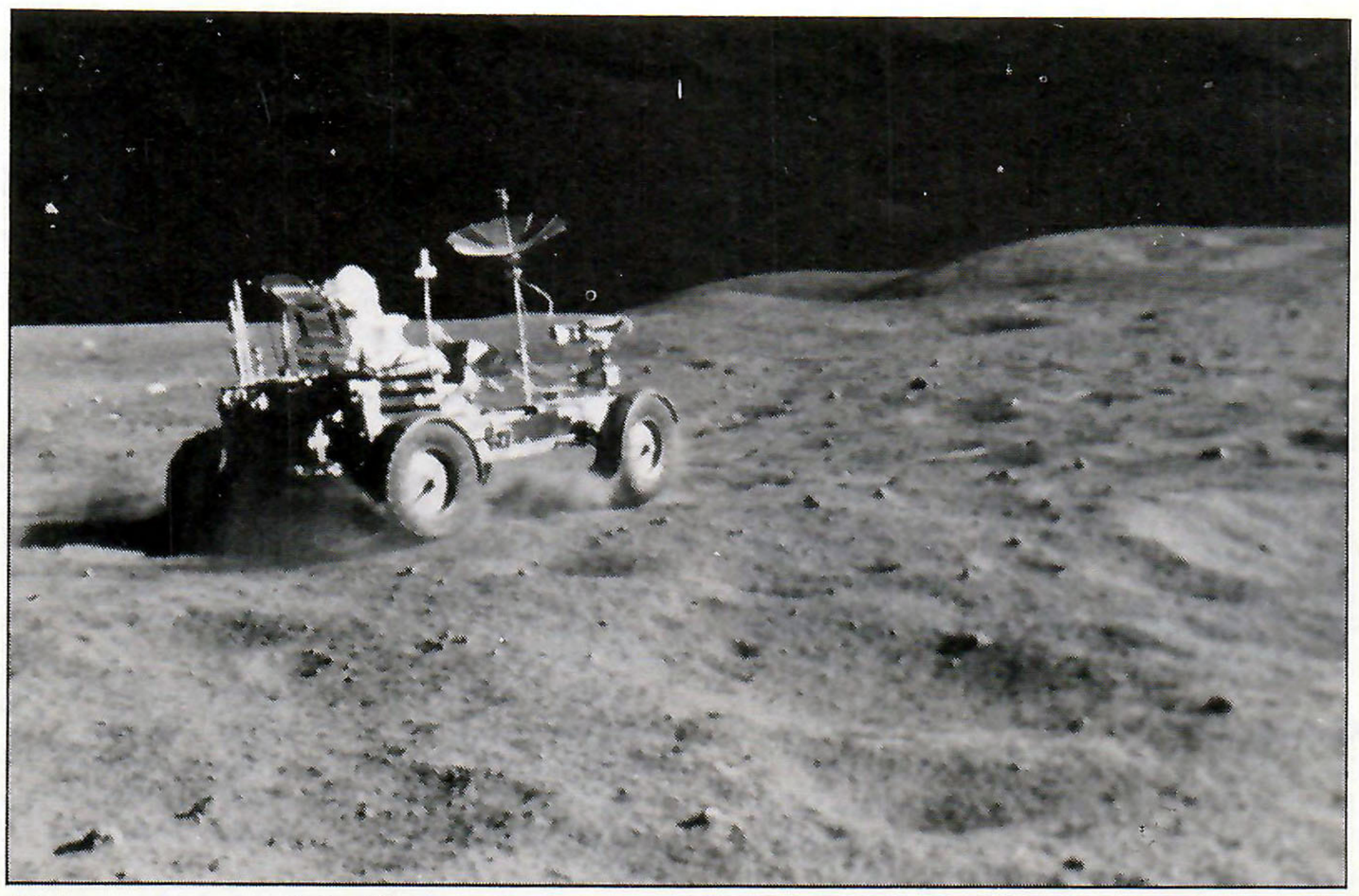
Of the 12 men who have walked upon the Moon, only one remains as an astronaut. This is John Young, who commanded the Apollo 16 mission to *Descartes* in April 1972. Nine years later he commanded the first Shuttle flight, and is, at present, chief of the Astronaut Office.

The previous astronaut to leave was Alan Bean, fourth man to set foot on the Moon, who resigned from the Astronaut Corps in June last year. He decided to devote his career full time to art, continuing an interest in painting that began with night school studies while he was a Naval test pilot. Al. Bean began as Lunar Module pilot on Apollo 12 and also commanded the second Skylab mission in 1973.

Soviet soil sampler for Venus

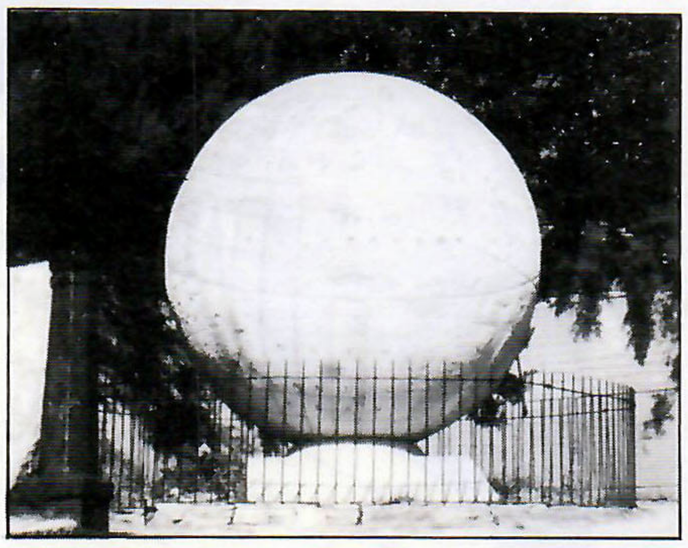
The Soviets did not have much luck with Mars; all their probes failed in one way or another, especially when compared to the incredible performance of the Viking craft. However, they have been very much more successful with Venus. Culminating with the landers, *Veneras 9* through *12*, plus the joint work with the US probes, Pioneer Venus Orbiter and Multiprobe, the wealth of information they returned far outweighs any other failure. They are continuing this exploration with *Veneras 13* and *14*, launched respectively on October 30 and November 4 last year. The area they are heading for is a result of information obtained from the Pioneer Orbiter and serves as a gratifying example of co-operation between the scientists of the two countries.

Veneras 13 and *14* are probably similar to their earlier comrades, but with one important difference. They carry soil-sampling equipment, a first for Venus, and only the second planetary sampling attempt after Viking. The probes are due to encounter Venus in March.

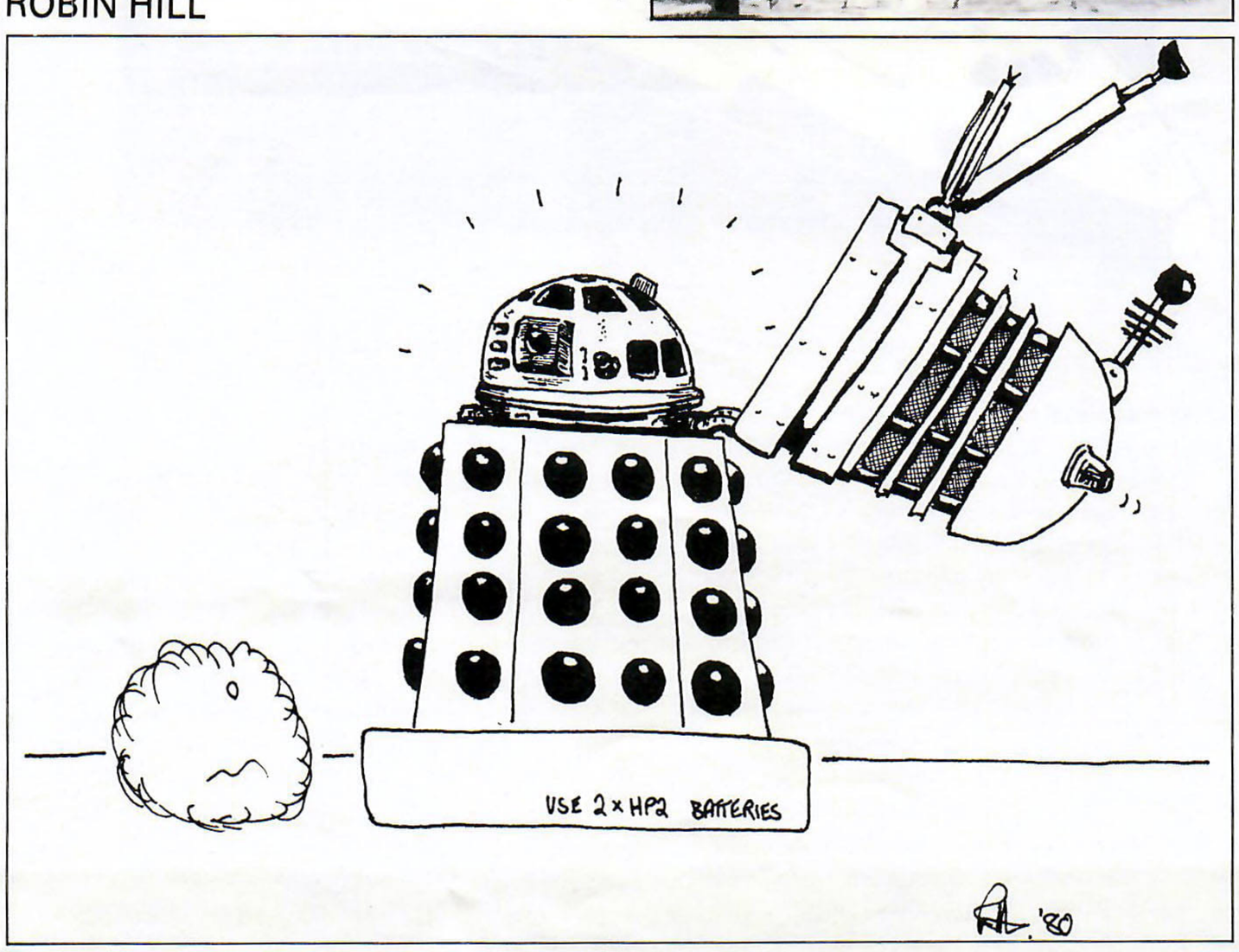


Above, astronaut John Young gives the Lunar Roving Vehicle a high speed workout during the third Apollo 16 EVA at the Descartes *landing site. Photo: NASA.*

Below, this 40 ton stone globe, built before World War One, is a prime feature of Durlston Head, Dorset. Made from Portland Limestone, the globe is some ten feet across. Photo: Mat



CARTOON BY ROBIN HILL



British satellite – over ten years in orbit

On October 28, 1971, Britain's first and only home-launched technology satellite *Prospero* was placed into an elliptical earth orbit by the Black Arrow rocket from the Woomera range in South Australia. Designed for one year's operation in space, *Prospero* has continued to provide useful information throughout its 10 year life.

British Aerospace Dynamics Group, Bristol Division (then British Aircraft Corporation) designed and manufactured the satellite's structures, handling equipment and did most of the environmental testing of the development and flight satellites. *Prospero* was the first satellite to be designed and built at Bristol. Since then British Aerospace has participated in over 30 international satellites, as well as nearly 400 sounding rockets.

As a technology-proving satellite, *Prospero* carries electronic modules for telemetry, data handling, power switching, etc., and experiments in ultra lightweight solar arrays, optical and thermal surface finishes and hybrid electronic assemblies. A scientific experiment by the University of Birmingham to measure the incidence of micrometeoroids (or space dust), for which British Aerospace made the electronics, is also on board. Much of this technology has been incorporated into subsequent British satellites like *Miranda* (X-4), *Ariel V* (UK-5) and *Ariel VI* (UK-6).

Prospero has recently been operating with its transmitter switched off to avoid possible interference with other satellites. It is reactivated at intervals to acquire further data from the solar cells and hybrid electronics experiments. The satellite is 1·1 metres (44 inches) in diameter and 0·7 metres (28 inches) high and weighs 72 kg (159 lb). Its orbit is inclined 82 degrees to the equator and it completes an orbit in 106·5 minutes. The estimated life-time before it re-enters the earth's atmosphere is 150 years.

Prospero was sponsored by the then Ministry of Technology (now Department of Industry). The Royal Aircraft Establishment, Space Department, Farnborough was the satellite's design authority and Marconi Space and Defence Systems was responsible for the satellite's electronics, spacecraft automatic check-out equipment and the launch operations team.

Meteosat-2

On June 19, 1981, Ariane, the European launcher, lifted off from the base at Kourou in French Guiana. Inside its nose fairing, Ariane was carrying three payloads: the 'CAT' technological capsule and two satellites – Apple, an Indian experimental communications satellite, and Meteosat-2, the second European weather satellite.

Following successful launch and a normal sequence of operations, Meteosat-2 was put into a high circular orbit by the European-made 'MAGE' Apogee boost motor, an operation which took place 15 hours and 40 minutes after lift-off while the satellite was above South America. This was followed by a series of attitude manoeuvres designed to give the satellite the correct spin axis and to bring its spin-rate up from the initial 10 rev/min to its final figure of 100 rev/min.

The satellite then drifted eastwards towards its intended position at 0° longitude which it reached during the early hours of July 21. During this drift phase, the main transponder and electronically-despun antenna were switched on.

After a series of performance tests on the satellite, the radiometer was brought into service on July 28, the first images in the two visible channels duly recorded at ESOC and the first infra-red images were received two days later.

At 13.00 GMT on August 11, 1981, the termination of the Meteosat-2 Launch and Early Orbit Phase was formally announced. By this date, all flight plan events had been accomplished, the spacecraft and its payload fully tested and accepted for mission operations with the exception of the Data Collection Platform (DCP) mission in which an anomaly was detected.

Regular dissemination of images from the European Space Operations Centre (ESOC), via Meteosat-2, to the data-user stations situated within the range of the satellite (Europe, Africa, the Middle East and parts of South America) then commenced.

UOSAT – in operation

On October 6 last, the UOSAT (University of Surrey Satellite) was successfully launched aboard the same Delta launch vehicle as the Solar Mesophere Explorer. Lift off, from the Western Space and Missile Center at 4·27 am, PDT, puts this country into space again. Built by a team of amateurs at the University of Surrey, UOSAT is the ninth in a series of OSCAR satellites (Orbiting Satellite Carrying Amateur Radio) and carried a number of experiments for scientific research.

UOSAT is the first such satellite designed to transmit data and photographs for display on

SHUTTLE NEWS

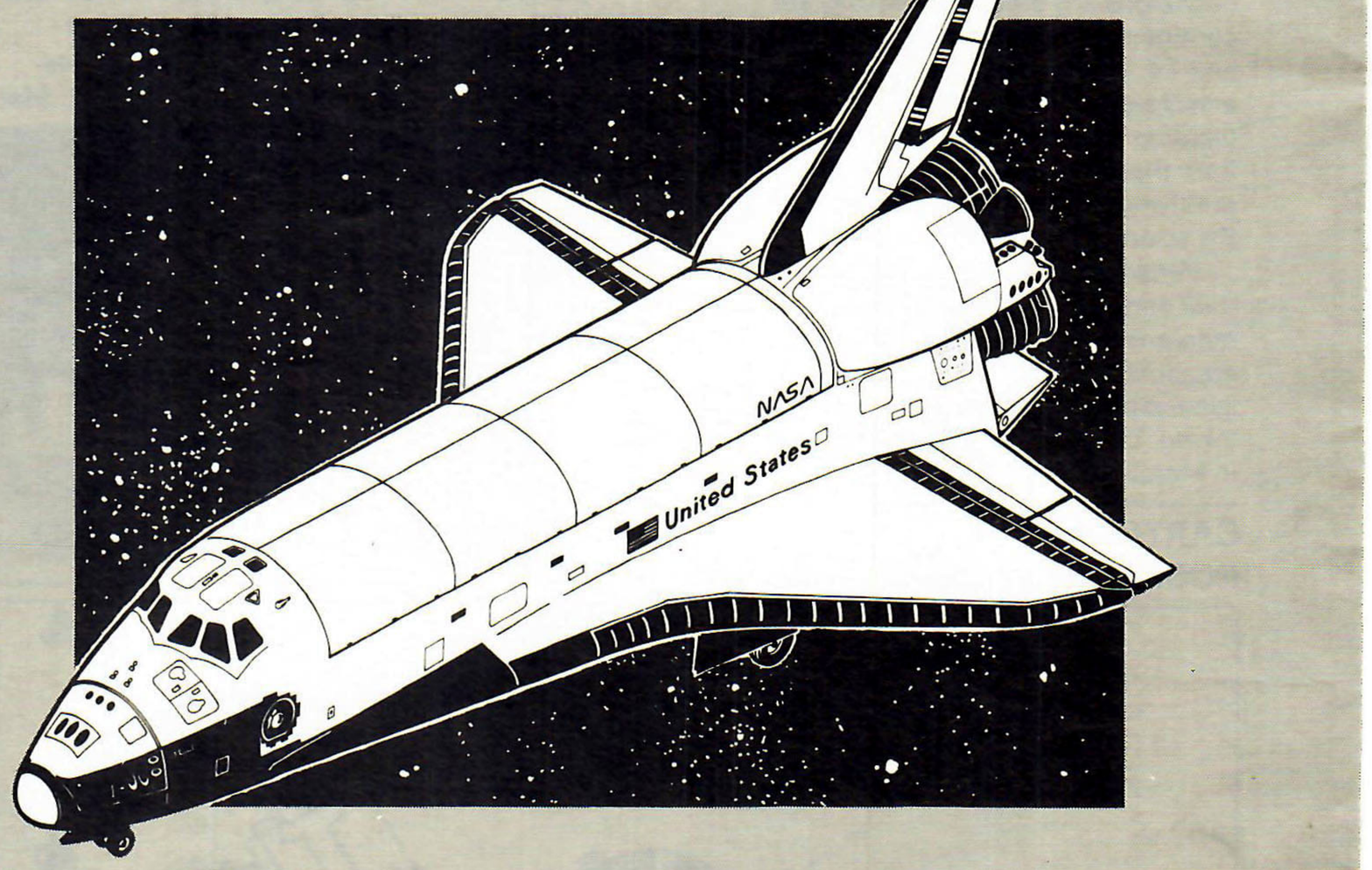
Space shuttle pallet on *Columbia's* second flight

The major engineering contribution made by Europe to the second flight of NASA's Orbiter *Columbia* was the reusable pallet carrying instrumentation of five scientific experiments, which examine global features of the air, sea and land.

Designed and built at Stevenage by British Aerospace Dynamics Group, Space and Communications Division, as the Government sponsored U.K. contribution to the European Space Agency's Spacelab project, the pallet is utilized as a versatile general-purpose carrier for payloads on Shuttle missions, as demonstrated by this particular application. Of modular construction, the pallets can be employed individually, or mechanically connected together, in trains of up to three to form continuous carrier units. An Orbiter cargo bay can accommodate five pallets separately, or linked together in suitable configurations, either as self-contained payloads or in conjunction with the European-manned space laboratory module.

The Shuttle pallet is a fully developed and proven item of equipment; its design has been verified in an extensive series of structural static and dynamic tests. 13 pallets have been built so far and supplied by the Space and Communications Division including five manufactured to full spaceflight standards. A further five flight-standard Spacelab Shuttle pallets are currently under construction for NASA.

A further, and very important, application of pallet technology will be required for the Intelsat VI programme. Some of the satellites are to be launched from the Shuttle and are to be carried within the cargo bay by a specially designed cradle structure. British Aerospace's unique experience gained from the development and qualification of the pallet is directly relevant to the Intelsat VI requirement, and the Hughes Aircraft Company's proposal to Intelsat allocates responsibility for this to BAe.



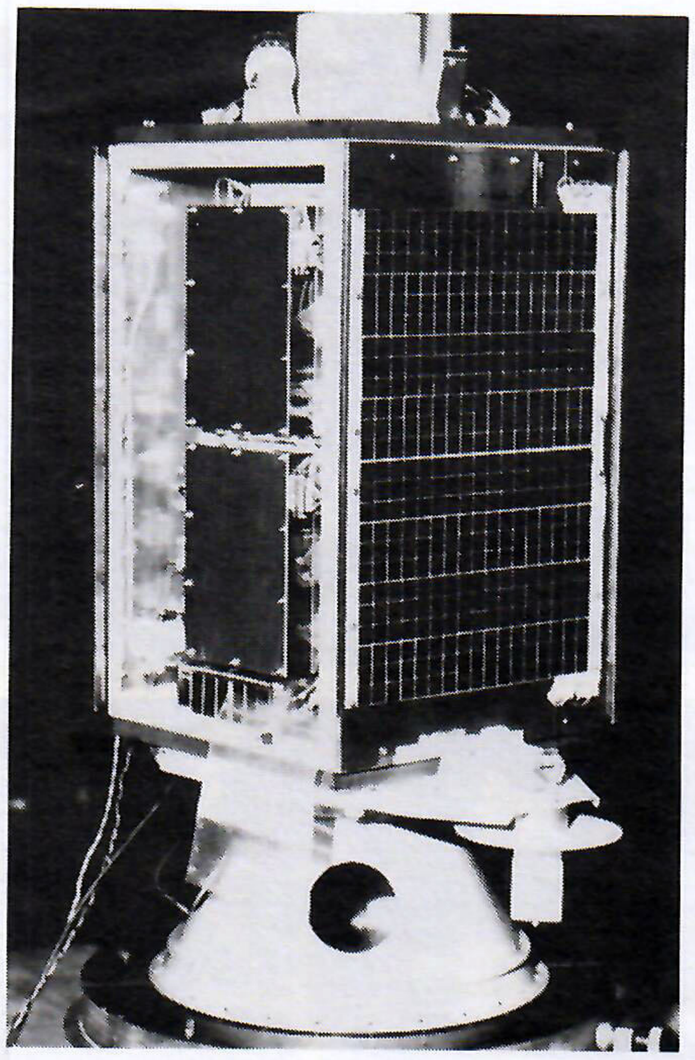
Shuttle pallets – future developments

A half-length pallet developed from, and compatible with, the full-length Shuttle pallet has been designed and currently completing qualification testing. Half-length pallets will increase the range of equipment-mounting facilities available for use with the Shuttle.

The maximum duration of an Orbiter flight is around 21 days. For experimental equipment that needs to remain in space longer, design studies have been completed into autonomous free-flying half and full-length pallets. These spacecraft would be provided with all the necessary sub-systems and would be released fom the payload bay of a Shuttle during its orbital flight. Such pallets, again equipped with suitable sub-systems, could also be utilized as functional elements in the construction of larger permanent free-flying space stations.

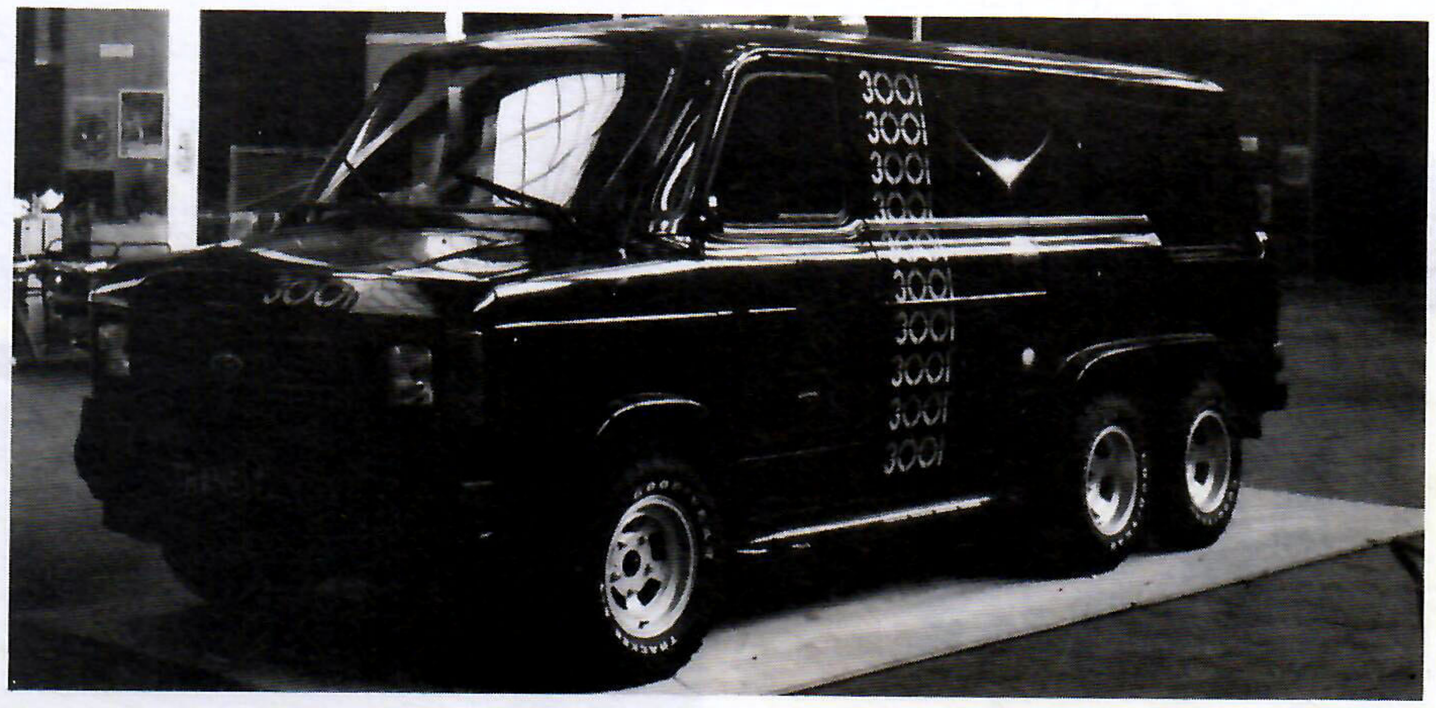
Orbiting Greenhouse

The third Shuttle flight, scheduled for launch later this month, will carry the first biology experiment aboard a Shuttle mission. This experiment will take the form of an orbiting greenhouse, with oat and bean seeds and pine seedlings under examination. The principal investigator is Dr Joseph Cowles of the University of Huston, who wants to study how gravity effects the growth of plants; particularly in the formation of lignin, which gives them their structural strength. The experiment is managed by Dr John Tremor of NASA's Ames Research Center who recently stated: *'When the Shuttle lands, the sprouts will be taken out for examination immediately – possibly even*



domestic TV sets. It also has a voice synthesizer on board for the relay of telemetry experimental data and spacecraft operations. The satellite's purpose is to stimulate interest in space science among students as well as providing radio amateurs with a 'tool' for studying our ionosphere. Data transmissions are on 145.825 MHz. You have been told . . .

Far left, the University of Surrey Satellite which was successfully launched last October from the Western Space Missile Centre, California.
Photo: NASA
Below, a futuristic 3001 van, based on a Ford Transit, as photographed by Mat Irvine.



before the astronauts are out . . .

Shuttle processing – the first steps

Representatives of firms that might be interested in bidding on a future contract to undertake Shuttle processing for NASA, have been invited to watch the complete cycle of preparation of the Space Transportation System for its third mission, Kennedy Space Center Director, Richard G Smith recently announced. Qualified companies had been invited to assign a limited number of their own managers and engineers to observe, and assess, the steps required from the time the Orbiter returned to Kennedy after its second trip, until it returns after the third mission this March. The group of observers will have no active role and no official responsibility for Shuttle processing operations at this stage. The invitation is an effort to give potential bidders every opportunity to learn what it takes to prepare Shuttle in order to assure knowledgeable competition when NASA solicits proposals for a Shuttle Processing Contract this Autumn.

The plan evolved after recent discussions with industry representatives invited to Kennedy to assist in planning activities. Smith asserted that NASA was *'anxious to demonstrate that a viable competition with the hardware developers is a realistic possibility. NASA is prepared to alter its traditional role of involvement in day-to-day Shuttle operations and redirect its resources to other activities more in keeping with the NASA research and development mission'* . . .

The new contract will cover refurbishment after flights of Orbiters in preparation for their next missions, checkout and assembly of other Shuttle elements, such as the external tank and solid rocket boosters, and responsibility for support operations and materials, including maintenance and operation of facilities.

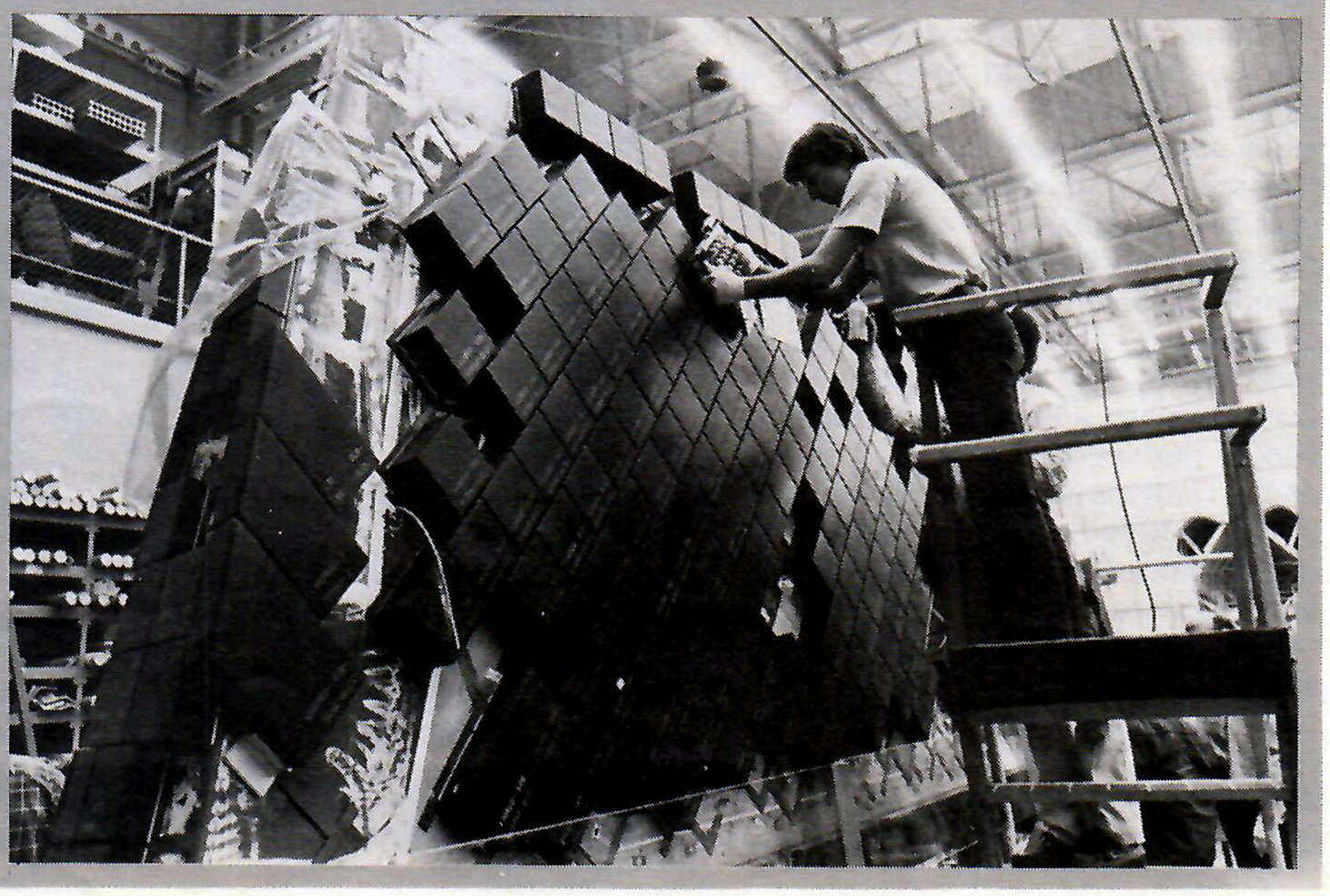
The Shuttle Processing Contract is the second of three comprehensive contracts that NASA intends to establish at Kennedy as the most effective and economical method of conducting future missions when the system becomes operational. The first contract, covering base operations, or institutional support services, is scheduled to be awarded later this year. The third, the Cargo Processing Contract, is not currently scheduled but is intended to follow the others.

Using the experience of industry representatives observing the processing of the Shuttle for its third mission, NASA plans to develop a statement of work for release in the Autumn. About nine months will be allowed for proposals, evaluation and negotiation of a new Shuttle processing contract and a six-month transition period is planned to permit orderly turnover after the contract is awarded next Summer. If the schedule holds, the contractors will begin full operations at the beginning of 1984

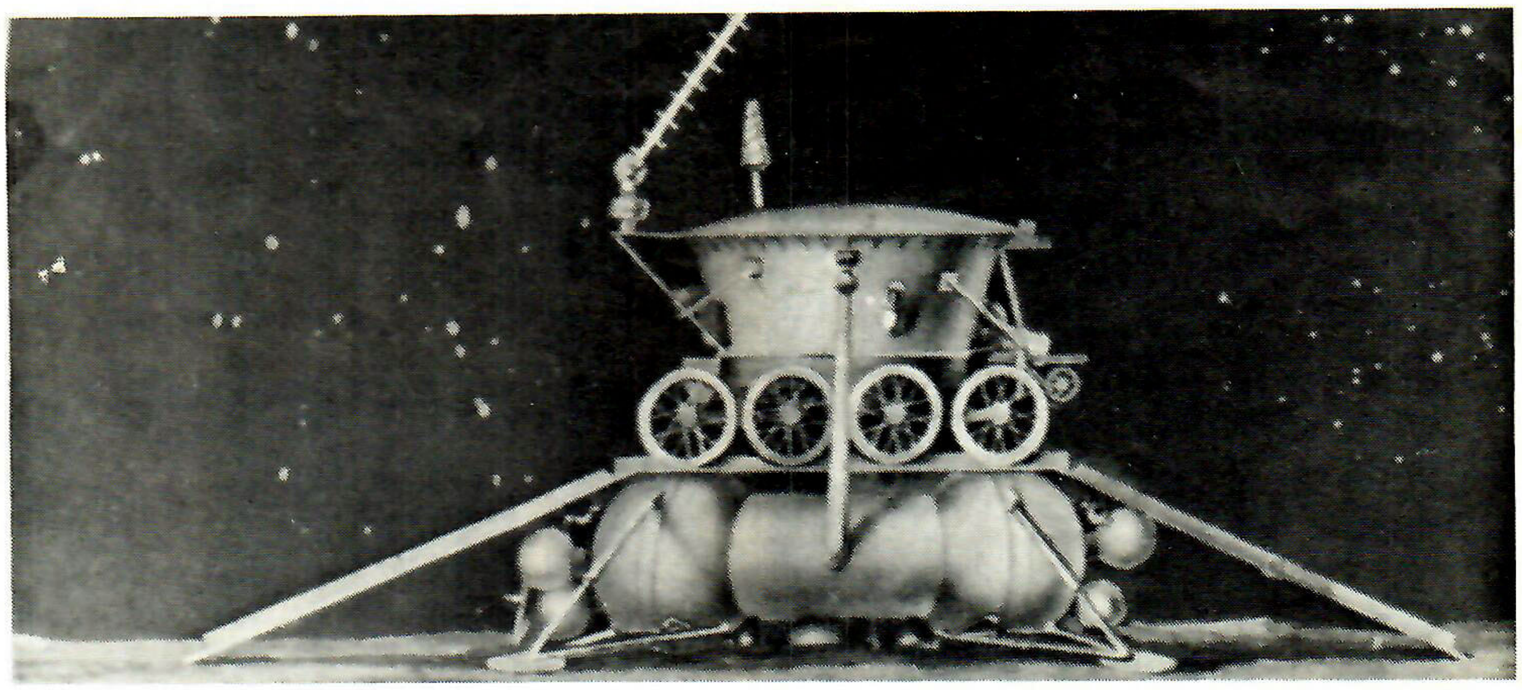
New protection for Shuttle

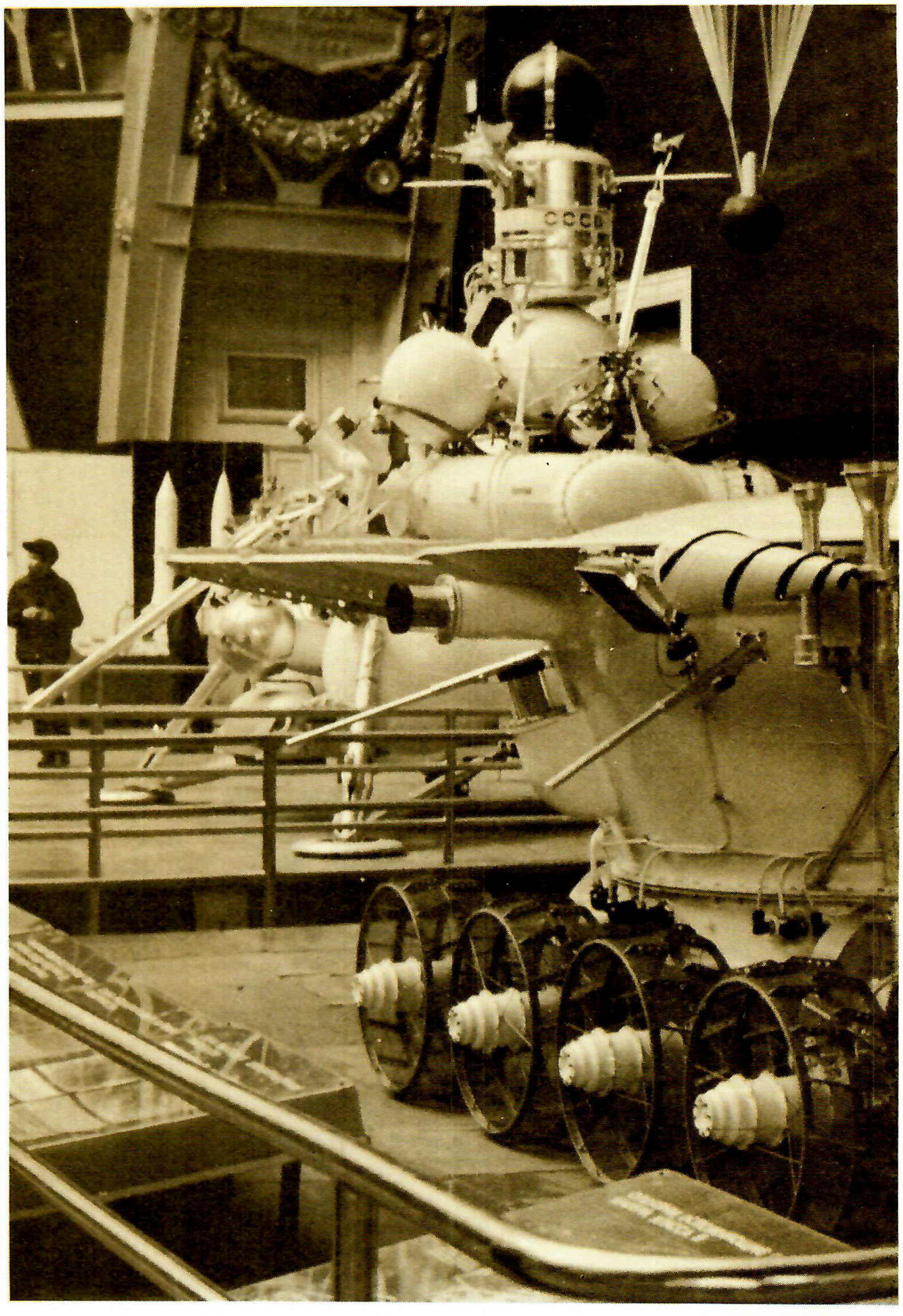
Those irritating tiles which have already caused a lot of problems for the Space Shuttle Orbiter are being replaced. Experiments have been done with alternative materials, not in the form of individual tiles, which will soon find themselves tested for real when the second Orbiter, designated OV-099, flies, hopefully, sometime later this year. Replacement at the moment is limited to the orbital manoeuvring system pods either side of the tail and consists of single pieces of blanket-like thermal material.

Meanwhile, work is also progressing on the third Orbiter, OV-103, and this craft will have more advanced, but lighter, thermal material (although still in the form of tiles) for protection areas such as the leading edge of the fin. The third Orbiter should be delivered to NASA late next year.



BATHTUBS ON THE MOON



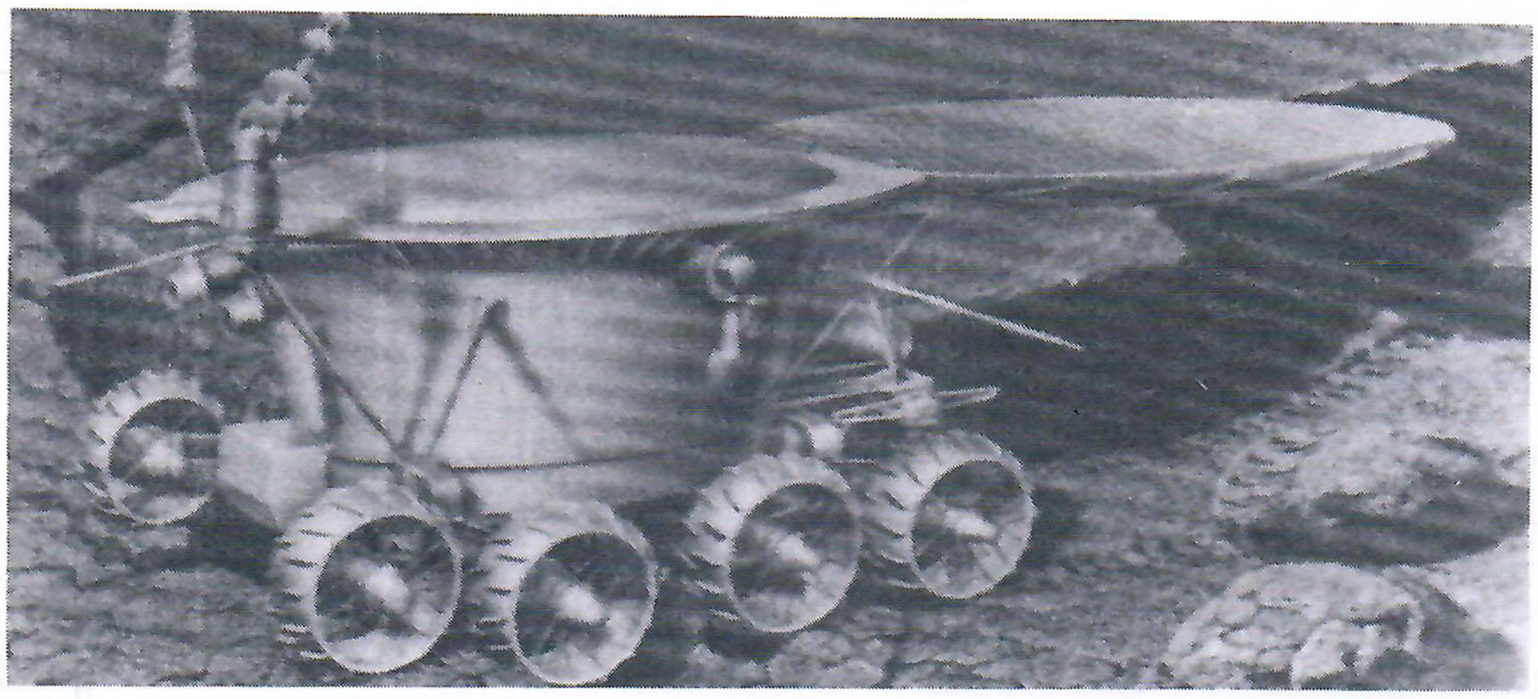


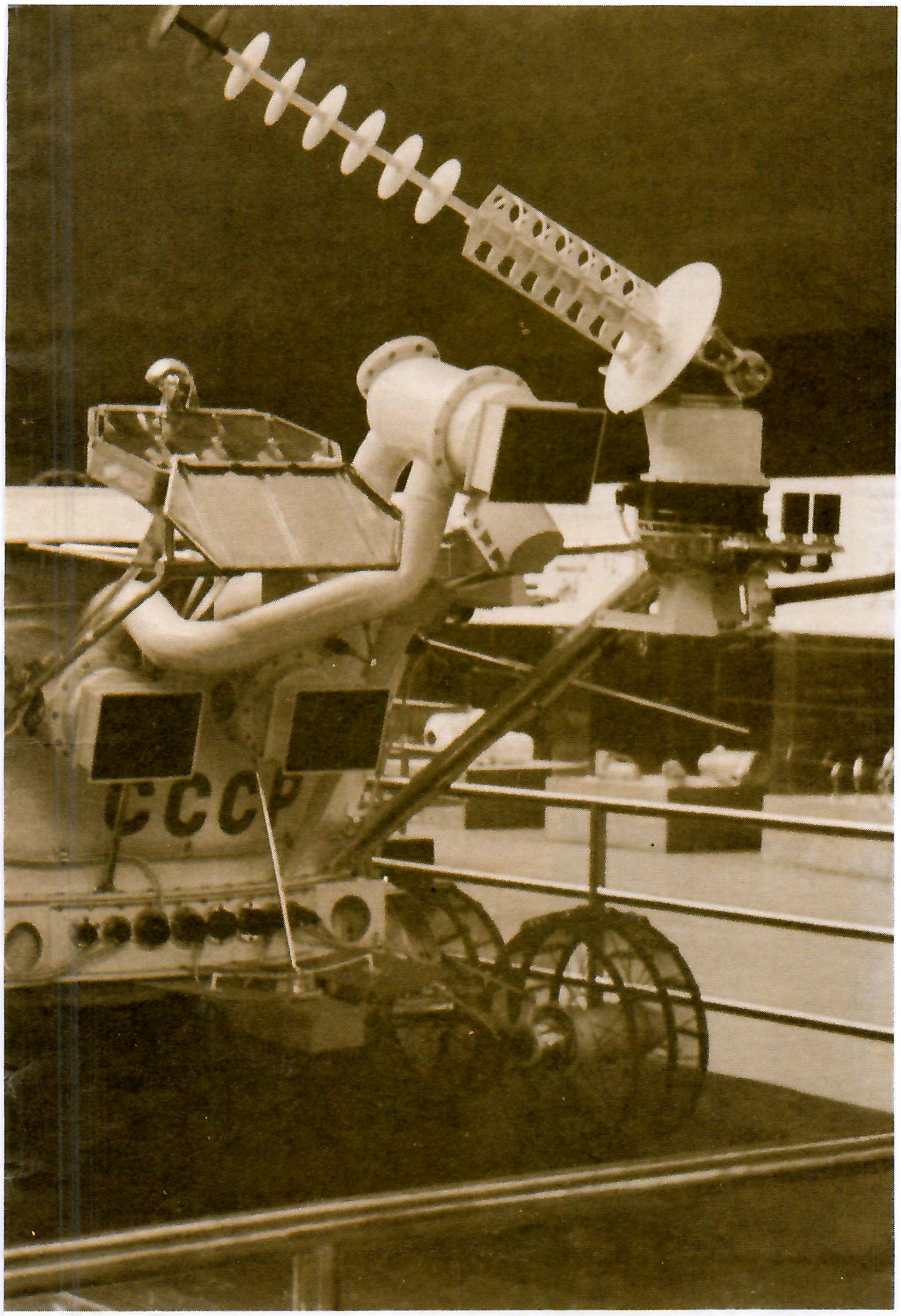
MAT IRVINE

There've been some oddly-shaped craft in the history of astronautics, but possibly none so odd as the one announced by the Soviets in late 1971. The news release was that an eight-wheeled, remotely-controlled vehicle had been landed on the Moon and was, at that moment, trundling around on the lunar surface.

The first pictures of the little vehicle were in the form of *Tass* drawings and I don't think anyone initially believed them. There was a device looking more like a bath-tub on spindly wheels than a spacecraft. However, it was true enough and by the time that photographs were released of the real vehicle, it could be seen that the *Tass* pictures had given a fair representation.

Lunokhod 1 was landed on the Moon on November 16, 1971, by the craft *Luna 17* (which was really no more than a landing platform) and once on the surface, ramps at either end dropped down to allow *Lunokhod* access to the lunar soil. Five scientists 'drove' *Lunokhod:* a commander, engineer, radio operator, navigator and the actual driver. All commands, of course, had to be given by radio and because of the time lag – nearly three seconds to the Moon and back – *Lunokhod* had a built-in emergency stop should the vehicle tilt beyond a certain angle. The eyes were a pair of TV cameras which provided the driver with a view directly ahead of the vehicle and gave a poor picture, but because it was transmitted at a fast rate, meant the driver at least had a chance of steering clear of any obstacles. The eight wheels were each driven independently and should one fail or jam it could be disconnected from the rest and the vehicle continued to





roll – *Lunokhod* could still move even if half the total number of wheels failed . . .

Electricity was generated by solar cells contained in the lid of the instrument container – the 'bath-tub' section; the lid opened during the lunar day to allow sunlight to re-charge the chemical batteries. Other equipment carried by the little vehicle included a French-designed laser for measuring the Earth-Moon distance extremely accurately, and there were also detectors which picked up X-Rays normally blocked out by the Earth's atmosphere.

Besides the driving TV cameras, a second system, with a higher quality transmission rate, provided scientific studies through four panoramic TV cameras. This system was similar to that earlier used by Soviet soft-landers, *Lunas 9* and *13,* and they gave an all-round view of the Moon's surface.

Lunokhod only worked during the Lunar day – 14 Earth days. Over the Lunar night it was parked in a convenient spot, with the antenna pointing towards Earth and the instrument container lid shut. With the first night over, and with the temperature down to —150°C, nobody could be absolutely positive that *Lunokhod* would survive the cold. But sure enough, after a few hours warming up, the solar cell lid was opened once again to re-charge the batteries and *Lunokhod* trundled off once more.

In total, *Lunokhod 1* worked for nearly a year – 322 days to be precise – had travelled 11 330 yards (10 300 meters or nearly six and a half miles) and sent back over 20 000 pictures. Considering its 'Heath-Robinson' appearance this was quite a magnificent achievement.

Lunokhod 2 was landed in January 1973 by *Luna 21* and although it initially did as well as its comrade, travelling over three times the distance, the transmissions suddenly stopped and it was thought that *Lunokhod 2* may have met with an ignoble end by falling into a crater.

Top left, TASS drawing shows Luna-17's Lunokhod ready to roll down the platform to the moon's surface. At top right, the TASS artist's impression of the vehicle underway. At right, the vehicle itself. Yes, it really** does **look like a mobile bathtub! Photos: via Mat

Over the last few years a new generation of games has hit schools, colleges and universities around the country. In this feature, *Steve Jackson,* one of Britain's first Fantasy Gamers, explains why players of such games have become so deeply involved in these 'alternative worlds' of the strange and fantastic.

SCIENCE FICTION AND FANTASY GAMES

...AN ALTERNATIVE REALITY?

"And as I raced down the corridor with the Goblin pack hot on my heels, I turned around a corner and ducked through a small doorway. Panting against the closed door I looked round to see a small room with miniature furniture, all covered in a metallic dust. Glaring at me from a small chair in the far corner was an old man about three feet tall. As I looked closer I could see that his right eye was, in fact, a sparkling jewel which became brighter as he stared. His eye flashed towards a coffin-shaped box to his right. Suddenly a large black shape reared into the air and, with a mind of its own, whisped towards me. I scrambled for the door handle but the door was firmly locked . . ."

No, that was not an excerpt from an H P Lovecraft tale, but part of an adventure from a Role-Playing Fantasy game. The situations encountered in these games are as many and as varied as those described in the thousands of novels, short stories and comics which have been published since the 1930s. Whereas *readers* are limited to being passive 'observers' of the imaginary worlds created by authors, Role-Playing *gamers* become characters which actually 'live' in the worlds of their games and can interact with the situations in which they find themselves in a way that is not possible through reading stories and comics.

In the strict sense of the word, these so-called 'games' are not games at all. No-one wins; no-one loses. There is never really an end to these games although, depending on the time available, they can last anything from an hour to a week or even years! They do not use boards, pieces or cards. Most of the action takes place in each player's imagination – the rules of the game and a handful of odd-looking dice are the only pieces of equipment necessary. Finally, there is no need for more than one of the players to know the rules at all . . .

Totally confused? Then let's go back in time to 1974 to trace the history of these games.

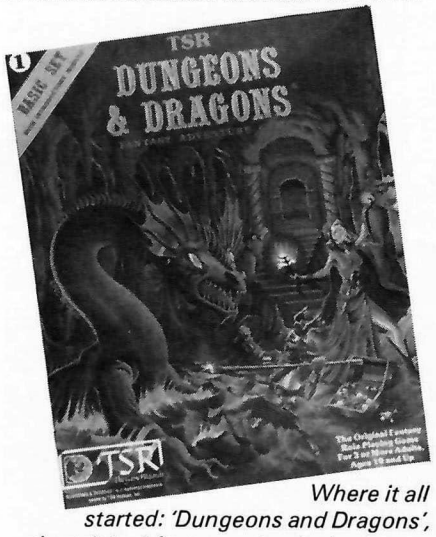
Origins

Although now a multi-million dollar industry in the States, the hobby was practically unknown in the early seventies. The **Avalon Hill Company** of Baltimore, specialising in detailed simulation board games re-enacting famous battles from history, were the largest name in the field. In England, and to a smaller extent in the States, wargaming clubs were also re-enacting historical battles on table-tops using miniature lead soldiers with home-made rules devised by interested players.

The first real 'cult' game was *Diplomacy,* a semi-abstract game based on the First World War. The rules were simple; between each move was a period of diplomacy when players were allowed to arrange joint attacks, support each other's troops and plot devious double-crosses. Because this diplomacy period was ideally suited to players who were not in the same room and thus could not see who their allies and enemies were negotiating with, the 'Postal Games Hobby' was born. This spread rapidly through universities and colleges via numerous amateur magazines ('Fanzines' or just 'Zines') which ran postal *Diplomacy* games.

The hobby was growing steadily and was served by a handful of small companies producing board games, table-top rules and metal miniatures – all run by players themselves in their spare time. One such company, **Tactical Studies Rules** based in the American mid-west, was on the verge of becoming a giant in the field and in 1974 the snowball started rolling.

Gary Gygax and Dave Arneson were two table-top gamers who preferred the medieval period and they had already written and published a set of medieval rules. With an interest in Science Fiction and Fantasy fandom, they devised an appendix to these rules to cover the various medieval monsters like Dragons, Goblins and Ogres so that players could send their medieval armies off to battle fantastic creatures no doubt inspired by the climactic battles in Tolkein's works. Rules for Wizards were added and these had a small armoury of spells, most of which had limited effect.



Where it all started: 'Dungeons and Dragons', the original fantasy role-playing game.

Around the same time, **Minifigs** (an English miniatures company) astounded the rather conservative wargames world by introducing a 'Mythical Earth' range of Hobbits, Orcs and Wizards based on Tolkein's 'Middle Earth' kingdom. Within a short time this became their best-selling range.

Meanwhile, Gygax and Arneson were putting all their efforts into a complete set of table-top Fantasy rules. But the more they worked on them, the further they got from traditional wargames rules. When in 1974, **Dungeons & Dragons** finally appeared, the role-playing concept emerged (albeit in a highly confused state) and immediately became the talk of the games world.

Most people believe 'Original' *Dungeons & Dragons* comprised a three-book set in a white box. In fact this was the *second* version of the game, revised from a former version which again contained three books but with a mock 'wood' effect box. This latter is now a sought-after collectors' item as, incidentally, are early out-of-print editions of *The Dragon* and *White Dwarf* magazines. A copy of *The Dragon* No. 1 sold recently in the States for over $50!

News of this wierd and wonderful Fantasy game spread rapidly throughout the hobby, through the various postal *Diplomacy* fanzines which was where the word first reached Britain and three young games players in West London, running a spare-time games mail order business, got hold of the game, became obsessed with it and immediately acquired the import rights.

Their **Games Workshop** proceeded to spend all its energy on popularising *Dungeons & Dragons* and *Fantasy Gaming.* The growth in popularity of the game sparked off a whole series of role-playing games. *Game Designers' Workshop,* an American board wargame company, put the idea to a Science Fiction theme with their *Traveller,* devised and continually developed by Marc Miller. Apart from the Science Fiction setting, *Traveller* introduced many new ideas to role-playing and is a more consistent and 'realistic' setting, being taken much more seriously by its followers.

Chaosium, a Californian company, developed their *RuneQuest* fantasy role-playing game not simply as a *Dungeons & Dragons* copy but to set a Fantasy game in a particular Fantasy world. Whereas *Dungeons & Dragons* is a sort of 'all-encompassing' system, *RuneQuest* is set in the world of *Glorantha* with its own particular cults, monsters and magic and this world is in a continual state of development as new areas are described and heroes emerge. As *The Lord Of The Rings* described Tolkein's kingdom of *Middle Earth* in such detail that the readers could actually believe there was such a place, the *RuneQuest* world of *Glorantha* has a similar depth through the game.

Various other games have since been developed, notably *Tunnels & Trolls,* a Fantasy game tackled at a very tongue-in-cheek level but having the advantage of a number of *Solo Dungeons* which can be played by a player on his own. *Boot Hill* is set in the American Wild West and pits gunslinging gangs against the townsfolk and sheriff.

Champions is a role-playing game based on the exploits of comic-type superheroes saving

ILLUSTRATION: FANGORN – COURTESY WHITE DWARF MAGAZINE

the world from megavillains while *En Garde!* puts players in the age of the Three Musketeers, duelling, drinking lots of ale, cavorting with loose women and eventually settling down to a respectable career in the army!

How Role-Playing works

Undoubtedly the main appeal of the role-playing game is its ability to allow for literally *anything* to happen. Wargames and *Monopoly*-type boardgames are designed with a rigid set of rules and although players can be creative in using the rules to give tactical advantage or build up an overall winning strategy, they cannot go beyond the rules to help them win. Role-playing games are designed so that players can choose to do *anything* that would be possible were they in the same situation in real life. As an example, a Fantasy game with rigid rules could never allow a player to find a Ring of Three Wishes and give the player unlimited choice as to what his three wishes would be. Setting out rules for all the possible choices would be an impossible task.

So how does a role-playing game account for an infinite variety of choices of actions? The secret lies with the fact that one of the 'players' must become the *Games Master* (GM) at each game. The Games Master is something like the banker in *Monopoly* but he cannot participate in the game in the same way as the other players.

Before a session starts, the GM must decide the scenario or setting for the game – perhaps a dungeon in *Dungeons & Dragons,* starship deck in *Traveller* or village tavern in *RuneQuest.*

Scenarios may be bought or can be designed by the GM himself who will have a plan of the area drawn out, together with an indexed key describing the various areas on the plan. A dungeon plan would show various rooms containing monsters or traps guarding treasure. The key would tell him, for example, that in one particular room there is a party of eight Goblins each having ten Gold Pieces in a pouch around his waist.

The GM will normally sit at one end of the table with all his plans and keys hidden from the other players.

The other players during the game will take on the roles of individual characters (hence 'Role-Playing' Games) to explore the GM's scenario and a particular quest in mind. In a dungeon the object may be to find as much gold as possible and come out alive. In a starship there may be an alien spy posing as a crew member who must be found and imprisoned or a deadly alien loose within the ship's air conditioning ducts which must be destroyed. (Recognise this? – all sorts of scenarios from films, TV and books can be reconstructed with these games).

By going through a procedure known as 'Rolling Up A Character', each player rolls dice to obtain scores for different personality attributes, *eg.,* Strength, Intelligence, Dexterity, Endurance and Social Standing. The scores rolled represent that character's strengths and weaknesses, thus you may roll a character who is puny but very bright, comes from a good family background but is clumsy. Everybody's character will be different.

These characters then assemble and the GM fills them in on what they will be doing. The dialogue may go something like this:

GM: 'You have just arrived at the village of Wartle on your way to find the Illska Skessa, an evil Troll-wife whose fortune in treasure is infamous. You are in the main street and can see various homes, hovels, shops and a tavern. What will you do?'

Players: (After some discussion) 'We'll go to the tavern.'

GM: (Checks his plan) 'You walk through the doors into a rowdy bar room. As you enter, the noise subsides and all eyes are turned towards you.'

Player A: 'I have the highest Charisma score. I bid them all "Good Day" and walk up to the bar.

GM: (Checks his index and confirms that the people of Wartle are hostile to strangers) 'The barman walks away. Someone in the crowd mumbles "We don't like strangers here." and everyone agrees.'

(The players discuss the situation and decide to try to win over the crowd with a juggling display. Player B has a high Dexterity score.)

Player B: 'I pick up a few objects and juggle for the crowd.'

Now we can see how role-playing games can accommodate *any* actions a player may wish to perform. The GM would normally give an average person a 15% chance of being able to juggle. Given Player B's exceptionally high Dexterity, he increases this to a 45% chance of success. He then rolls special 'Percentage Dice' and his roll indicates that the juggling show *is* a success. The locals then loosen up and tell the players how to get to the Illska Skessa. On their way they are ambushed by Forest Trolls . . .

Battles and skirmishes form an important part of the situations. Most role-playing games have a basic 'Combat System' which can be made more realistic, and hence more complicated, with optional advanced rules. Magic is handled in a similar way. The rules for both these systems originally developed from tabletop wargame rules, but on a 'one-to-one' basis *ie.,* individuals fighting individuals.

Battles are resolved, and 'chances of success' at any particular choice of actions are worked out, by rolling special dice. Using these, the Games Master can accommodate any suggestions players may make about their

intentions. The Games Master is an adjudicator or a sort of 'God' for his scenario, playing the parts of monsters or aliens encountered and determining random events. Although he doesn't actually *play* the game with the other players, he controls his game-world and ends up having as much, if not more, fun.

How do I start?

Most role-playing games, particularly the big names, are sold as a 'Basic Set' which give newcomers an introductory chapter on how a game should run. Perhaps the best starter set is *RuneQuest* which includes a booklet entitled *Basic Role-Playing.* This booklet promises to get you playing in 30 minutes, and is available separately at around £3.

Strange dice are also needed in addition to normal six-sided *Monopoly*-type dice, but these vary from game to game. Four-sided, eight-sided, ten-sided, 12-sided and 20-sided dice are all available from game shops or by mail order at around 50p each. In the *Basic Role-Playing* book, cut-out chits are included to replace dice, although most players will want to use dice anyway since cardboard chits are very fiddly to use.

Traveller and *Dungeons & Dragons* are both available as 'Basic' sets and once the general rules have been mastered a whole string of accessories and supplements can be obtained to expand the games. A word of explanation would doubtless be in order to explain what the various add-ons to these games are:

SUPPLEMENTS: Books which expand on the basic rules to a game, usually giving depth to one particular aspect. *Animal Encounters,* for example, gives details of how to encounter and fight a multitude of animals in the *Traveller* universe. Supplements are not essential but give the basic games more depth in a particular field.

SCENARIOS: These are the adventure settings in which the games take place. They are generally bought as books with or without loose-leaf charts which map out the areas to be explored (dungeon complexes, starships or alien cities). Games Masters may prefer to design their own scenarios but the ready-made ones are tried, tested and usually more complete. In *Dungeons & Dragons,* some of these scenarios are called *Modules,* in *Traveller* they are *Adventures* and in *RuneQuest* they are *Scenario Packs.*

CHARACTER SHEETS: These are useful play aids for players to record their own characters' characteristics on a handy reference sheet.

Book 3
Worlds and Adventures
TRAVELLER
Deluxe Edition
This is Free Trader Beowulf,
calling anyone. . .
Mayday, Mayday. . . we are under
attack. . . main drive is gone. . .
turret number one not responding. . .
Mayday. . . losing cabin pressure
fast. . . calling anyone. . . please help. . .
This is Free Trader Beowulf. . .
Mayday. . .
TRAVELLER
Science-Fiction Adventure
in the Far Future
The Spinward Marches

Without Character Sheets, these tend to get recorded on scraps of paper and ultimately lost!

GAMES MASTERS' SHIELDS: As the Games Master must keep his maps and notes hidden from the other players, he usually puts up some sort of screen. A Games Master's shield hides his notes and is printed with various tables and charts for handy reference.

MINIATURES: Although not essential for play, most players prefer to give their games a visual aspect by using miniature figures. The normal scale for miniatures is 25mm and hundreds of different adventurers, monsters and aliens are available from **Citadel Miniatures, Asgard Miniatures** and other manufacturers or through game shops. These miniatures are centrifugally cast in white metal, a lead-based alloy, and are bought unpainted. Painting miniatures is for many people a hobby in itself. They are useful in the games for resolving combat and give players a much clearer idea of what's going on. Prices range from around 25p upwards. (See **Products** column for a selection of fantasy figure reviews).

FLOOR PLANS: From the players' points of view, mapping the scenario as they explore is always a problem. To overcome this, various companies have come out with Floor Plans made to scale for miniatures. Representing passageways and rooms, these are laid down on the table to 'build up' a map in front of the players to move their miniatures on.

To sum up, then, the newcomer can enter the world of Fantasy Role-Playing for as little as £3 with *Basic Role-Playing.* With a larger budget, *Dungeons & Dragons* (£8.50) or *RuneQuest* (£14.95-but shortly to be published in the UK at a lower price) will both give more than an introductory game and both of these are expandable with supplements, scenarios and playing aids. For Science Fiction fans, *Traveller* can be bought as a £5.95 boxed set (dice are extra) or as the *Deluxe* version, soon to be published in Britain. Of the two, the Deluxe version is better for beginners as it contains an 'Introduction to Traveller' book. Most beginners like to start with a few miniatures and here a budget of around £3 will give a selection of character figures plus a few monsters or aliens.

A mention should also be made of the magazines available to keep players in touch with news and ideas on the games. *White Dwarf* is the only professional magazine published in Britain for UK gamers. At 75p, it is considerably cheaper than imported magazines and reports British news, clubs and adverts. It is available from most game shops or on subscription from Games Workshop. *The Dragon* is the best-selling US magazine and *Different Worlds* and *Space Gamer* are two other imported magazines of high quality. Several magazines deal specifically with particular games. The *Sorcerer's Apprentice* is the *Tunnels & Trolls* magazine; *Journal of the Traveller's Aid Society* deals with *Traveller* and *Wyrm's Footnotes* is now dedicated to *RuneQuest.*

Sources

At one time it was difficult to find a local stocklist of fantasy games but their rise in popularity has inevitably lead to more shops taking role-playing games. Most towns of any reasonable size have at least one stockist, although these tend not to be toy shops but rather hobby and model retailers. The last few years have witnessed the growth of a number of specialist game shops in London, Birmingham, Manchester, Liverpool, Edinburgh, Newcastle, Glasgow, Brighton, Norwich, Aberdeen, Cambridge, etc., and all these stock a good selection of role-playing games. Many smaller towns are serviced by stockists who only keep numbers of the best-selling games and there are still many towns without a stockist where players must use Mail Order services from the major distributors.

Over the next few years we can expect to see many more games shops and shops stocking Science Fiction and Fantasy games; it is indeed true to say that Science Fiction games are the games of the future!

For those interested in finding out more about Science Fiction and Fantasy games of all types: role-playing, board games, family games and miniatures, Games Workshop publish a free 'Introduction to Hobby Games' leaflet. For your copy send a stamped, addressed envelope to Games Workshop, 29 Sunbeam Road, London NW10. (Telephone: 01-965 3713).

Above, the Deluxe Traveller Science Fiction role-playing game from Game Designers' Workshop. At left, RuneQuest from Chaosium Inc., the fantasy world of Glorantha and hugely popular. Photos: Steve Jackson

Publishers' note:
Dungeons & Dragons is a registered trademark of TSR Hobbies Inc, USA
Traveller is a registered trademark of Game Designers' Workshop Inc, USA
RuneQuest is a registered trademark of Chaosium Inc, USA.

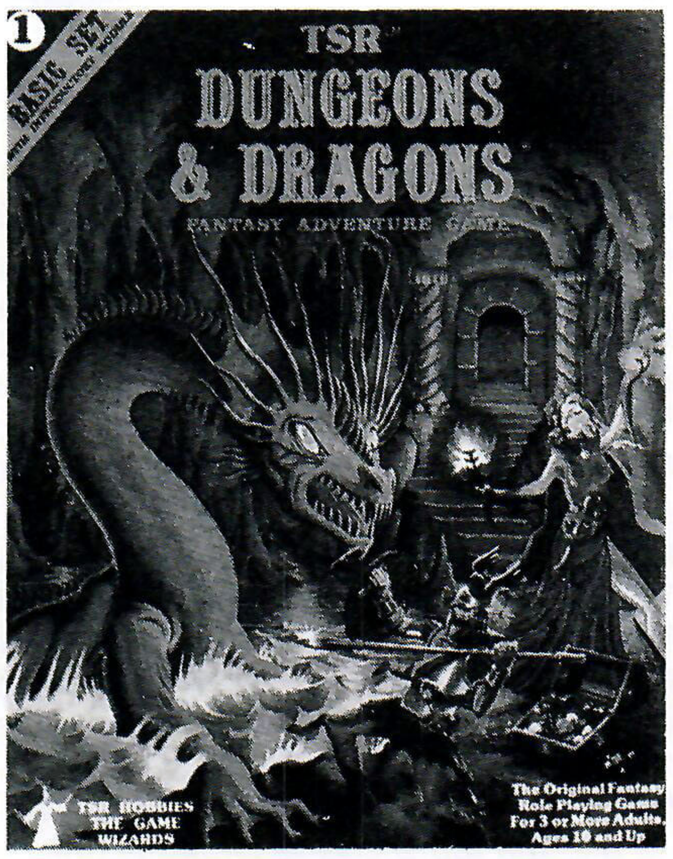
You are Lazlo Plum, billionaire and mercenary, clad in powered vac-suit, disintegrator weapon gripped in a jewelled gauntlet. You had friends once but they disappeared in an asteroid storm. Now, crippled, your ship has crash-landed on some two-bit shanty world. Tired and dispirited you watch as a rabble of underlings approach, thirsting for loot. What will you do?

Well what would you do? This is a possible scene from the science fiction role-playing game *Traveller.*
In *Traveller* you are somewhere far away in time. You play a character that you create yourself, out among the stars. Free-booting for fame and fortune.
But if science fiction isn't your real interest, why not try one of the other best-selling role-playing games?

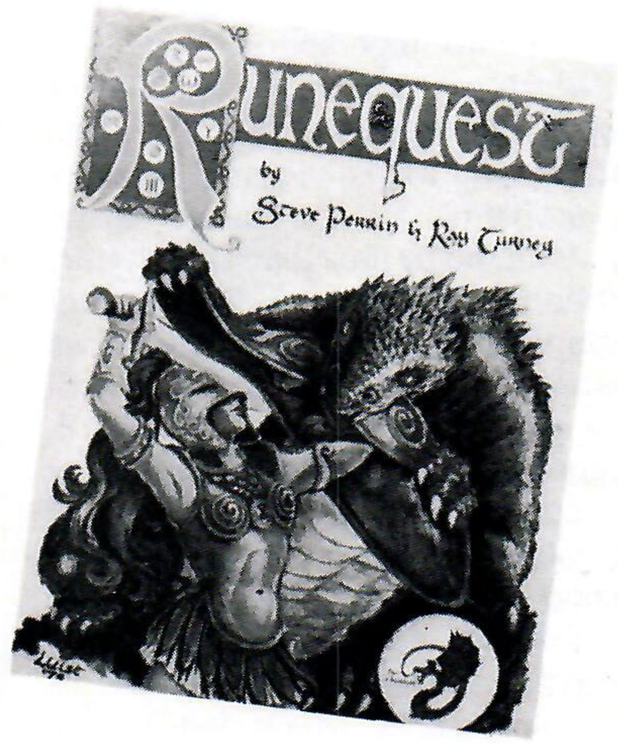
With *Dungeons & Dragons* you can enter a world of swords and scorcery. Or you could become a hero of the mythical world Glorantha, with *Runequest.*
You read science fiction and fantasy novels, you see the movies, but with a role-playing game you can enter a different world yourself. All you need is some time, imagination and a few friends to begin your adventure.

This is Free Trader Beowulf:
calling anyone
Mayday, Mayday we are under attack main drive is gone
turret number one not responding
Mayday losing cabin pressure
fast calling anyone please help
This is Free Trader Beowulf
Mayday
TRAVELLER
Science-Fiction Adventure in the Far Future
Game Designers' Workshop

Traveller contains the game system - three modules, 'Starships', Characters & Combat', and 'Worlds & 'Adventures'. That's everything you'll need to begin playing except for two six-sided dice.
£5.95 POST FREE.


BASIC SET
TSR
DUNGEONS & DRAGONS
FANTASY ADVENTURE GAME
TSR HOBBIES THE GAME WIZARDS
The Original Fantasy Role Playing Game For 3 or More Adults Ages 10 and Up

Basic Dungeons & Dragons comes boxed, with complete rules and an introductory adventure 'The Keep in the Borderlands'.
£8.50 POST FREE.



Runequest contains the booklet 'Basic role-playing', an introductory adventure, 'Apple Lane', 'Fangs'- prepared monsters and non-player characters, the *Runequest* rules system and the six polyhedral dice that you will need to play.
£8.95 POST FREE.

Traveller, Dungeons & Dragons and *Runequest* are available nationwide from better games stores, including our own at:

1 Dalling Road, Hammersmith, London W6. Open Monday-Saturday 10.00-5.30.
6 St.James's Square, off John Dalton St., Manchester M2. Open Monday-Saturday 9.30-5.30.
Unit 37, Birmingham Shopping Centre, Birmingham B2. Open Monday-Saturday 9.30-5.30.

Games Workshop Ltd., Voyager Dept., 27-29 Sunbeam Rd., London NW10

Traveller Price £5.95 Post Free Qty . . . . . Total . . . . .

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Traveller is the registered trade mark of *Games Designers' Workshop.*

X-15

BY BARRY C. WHEELER, EDITOR OF 'RECOGNITION JOURNAL'

When *Columbia* lifted off from Pad 39A at the Kennedy Space Centre, Florida, in April 1981, the success of the whole Shuttle system owed much to years of research into high-speed flight. Research which yielded countless bits of information on materials, structures and systems, as well as highlighting environmental problems for the future space traveller. Initiated by the National Advisory Committee for Aeronautics (NACA) after World War Two, the X series of aeroplanes was instrumental in obtaining much of this data and one in particular, the X-15, can be considered to be the forerunner of today's spacecraft. No other manned aircraft, before or since, has achieved speeds and altitudes like those reached by this remarkable machine and its ilk is unlikely to be seen again.

The requirements which led to the development of the X-15 were, in 1952, ambitious and would push man's aerospace resources and knowledge to the very limits. In June that year, NACA's Aerodynamics Committee decided that it should expand its research aircraft programme and include a design to investigate manned flight from 12 miles to the borders of space and at Mach numbers between four and 10. Proposals were exchanged by a number of NACA laboratories and in October 1953, the US Air Force concluded that development should be started on a hypersonic research aircraft capable of Mach 6+. The US Navy too, had an interest in such a project and in June 1954, NACA's research director Hugh Dryden, invited both Services to join the Agency in formulating a joint research aircraft programme under the title *Project 1226*. In December, what was subsequently to be called the X-15 Committee, was established with a three-man team comprising Hugh Dryden, Brig. Gen. Benjamin Kelsey (USAF) and Rear Admiral R S Hatcher (USN). It was agreed that NACA would have technical control of the aircraft and conduct flight tests, while the Air Force and Navy would jointly fund the design and construction. On December 30, the Air Force sent invitation-to-bid letters to 12 prospective contractors – the demanding requirement being a design capable of reaching an altitude of 250 000 feet and an airspeed of 6600 ft/second.

By May 1955, the competition had only four front-runners; Bell, Douglas, Republic and North American. On August 5, following submission of the final technical reports, the X-15 project office judged North American the winner. Doubts were raised within the company that such an advanced design could be tackled, given North American's heavy defence commitments involving, among other things, the F-86 Sabre and the supersonic F-100 Super Sabre production programmes. But the order was taken up and the top secret X-15 project office was established in Building 20 alongside the work's canteen at North American's plant adjoining Los Angeles International Airport.

Three airframes were ordered, each made of Inconel-X chrome nickel alloy, a material initially suggested for this project by NACA's Langley Laboratories. The design shape too, owed much to the Langley proposal, a cruciform tail unit being adopted which would give better directional stability at high Mach numbers. To reach the demanding performance, drastic weight-saving procedures were made. It was decided that the aircraft would be air-launched and retrieved conventionally using retractable skids. This eliminated the use of heavy undercarriage components although a lightweight nosewheel was installed. The lower part of the tail was jettisoned prior to landing. Overall dimensions eventually came out at a length of 50 feet 9 inches and a span of 22 feet 4 inches.

One of the X-15s on Rogers Dry Lake at the NASA Flight Research Centre, Edwards AFB California. Over 20 years later, Columbia *touched down here . . . Photo: NASA*

An air-conditioning system, using liquid nitrogen, was provided by Garrett AiResearch, one of the programme's many sub-contractors. This would pressurise the cockpit, the pilot's suit and cool the X-15's instrumentation bays. No less than three flight controls were installed. A conventional stick for control during the landing and touchdown, a sidestick for launch, climb and re-entry, while a reaction control unit managed the hydrogen peroxide thrusters which would keep the craft under control at altitudes where its aerodynamic control surfaces were ineffective.

In addition to the airframes, the pro-

X-15 66670 seen here under the starboard wing of its mother-ship, a Boeing B52 of the United States Air Force.
Photo: NASA

gramme called for the development of a new liquid-fuel rocket engine, the establishment of a 485-mile test range, the modification of two B-52 bombers as carrier aircraft (B-36s were originally proposed) and the provision of complete environmental protection for the pilot. An ejection seat with the thrust of an F-86 Sabre engine was also developed which could operate at up to Mach 4 and 120 000 feet.

The engine proved to be the project's single biggest problem. Reaction Motors Inc. decided to modify the XLR-30, which powered the Navy's Viking research rocket, into the 57 000 lb-thrust XLR-99. This derivative engine burned 1000 gallons of liquid oxygen and 1445 gallons of anhydrous ammonia. As the XLR-99 was badly behind schedule, it was decided to install two 8000 lb XLR-11s for the first series of contractor-proving flights and it was with these powerplants that the second X-15 (56-6671) made the aircraft's first powered flight on September 17, 1959.

The official roll-out occurred almost a year earlier on October 15, 1958, the craft being transported to Edwards Air Force base the following day. Programme project pilot was A Scott Crossfield, an experienced test pilot and engineer, previously working for NACA on the earlier X series of aircraft. On March 10, 1959, Capt. Charles Bock, mother-ship pilot, took the eight-jet B-52 into the dry air of Edwards with the black X-15 tucked under the inboard starboard wing, Scott Crossfield successfully checking out the craft on its first captive flight. This was followed three months later by the first free unpowered flight. The initial September 17 mission took the X-15 to Mach 2.11. But in November a set-back occurred when the aircraft suffered an engine ignition failure after launch and broke its back in an emergency landing on Rosamund Dry Lake; it took three months to repair. Main cause of the accident was found to be a lack of oil in the nosewheel oleo leg due to evaporation which failed to cushion the aircraft on touchdown.

The first XLR-99-powered X-15 made its initial flight on November 15, 1960, and all three aircraft had been delivered retrofitted by June 1961. By the end of the year, the remarkable machine had achieved its design objectives of Mach 6 and 200 000 feet.

In 1962, the X-15 Committee approved a decision for a Follow-on Research Programme. This involved the first and third X-15s conducting experiments designed to support space science research and the Apollo programme, while the second aircraft – rebuilt by North American following a crash in Nevada in November 1962 – would be extensively modified for speeds of Mach 8 with provision for external fuel tanks to increase performance. Designated X-15A-2, this rebuilt aircraft had a fuselage stretch of 29 inches and two 23·5 feet-long jettisonable tanks containing anhydrous ammonia and liquid oxygen. These would be dropped at Mach 2 and 70 000 feet and would provide propellant for an increased engine burn time from 86 seconds to 145 seconds. The X-15A-2 made its first flight on June 25, 1964, piloted by Air Force test pilot Robert Rushworth.

Preparatory to flights above Mach 4, the craft was coated with a resin-based ablator designed to prevent the structure from heating above 2000°F. Experiments were to be conducted by the National Aeronautics and Space Administration (successor to NACA from 1961) with a hypersonic ramjet and the A-2 was fitted with a dummy shape of the proposed engine on the ventral stub which had been specially shortened and reduced in height. The first flight of the A-2 version was made on August 21, 1967, by Air Force pilot William Knight, attaining Mach 4.94. This was followed on October 3 by a second flight reaching Mach 6.72 or 4520 mph at 102 000 ft. However, this second flight resulted in unplanned-for complex airflow characteristics around the dummy ramjet and this was burned off the ventral pylon and seared a large hole in the lower fuselage taking the craft to the edge of a catastrophic structural failure. With the aircraft's exterior badly burned, despite the ablator, it was decided not to fly the machine again. Thus, the world's fastest winged aircraft, repaired and refurbished by North American, was retired to the Air Force Museum at Wright Patterson AFB.

Sadly, the third X-15, holder of the aircraft altitude record of 324 200 ft by NASA pilot Jo Walker on August 22, 1963, was lost, just over a month after Knight's epic flight, with the untimely death of its pilot Major Michael Adams. An increasingly-severe pitching oscillation started when the aircraft was at Mach 3.93 at 62 000 ft, induced by an advanced MH-96 flight control system with which the aircraft had been fitted, and the craft broke up near Johannesburg, California. With this accident went NASA's plans to modify the X-15 into a ramjet-powered slender delta.

The remaining first aircraft continued to fly through most of 1968. Then, on October 24, NASA pilot Bill Dana completed the aircraft's 81st flight, and unknowingly the last by an X-15. The magic figure of 200 flights by the three aircraft was never to be achieved, the scoreboard standing at 199 despite efforts to make that one last mission. The elements at Edwards triumphed over man and bad weather robbed the team of their final goal. With no funds allocated for further X-15 flights after December 1968, the aircraft was presented to the National Air and Space Museum of the Smithsonian Institution in Washington. It now stands in the 'Milestones of Flight' gallery.

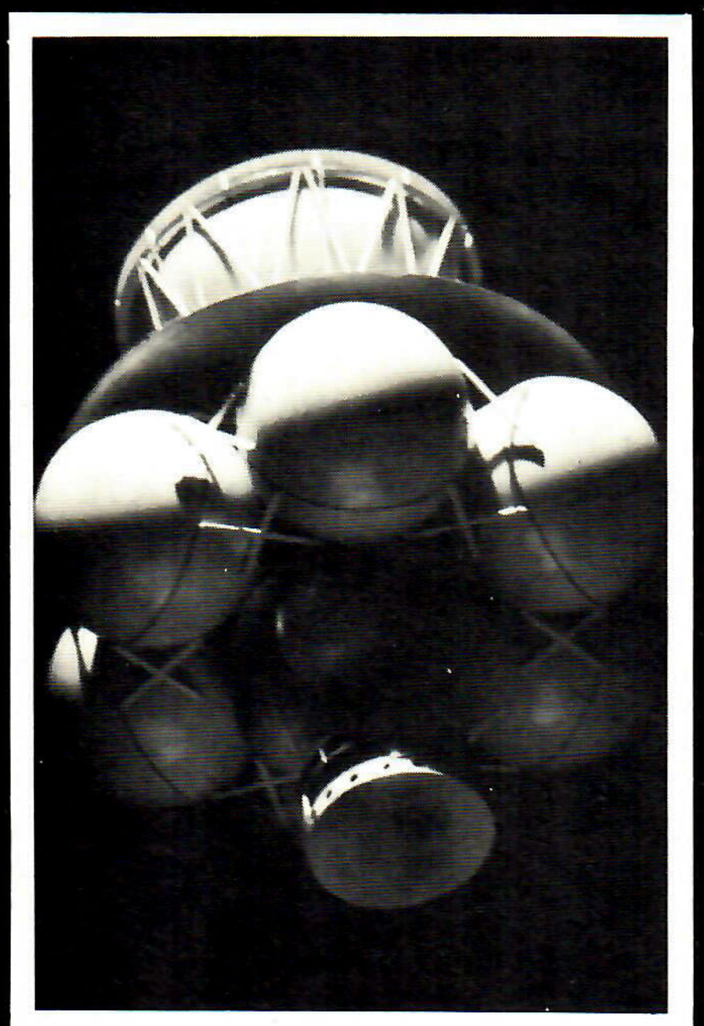
Before Apollo – X-15 pilot Neil Armstrong poses proudly for the cameraman. Armstrong was one of six pilots assigned to the X-15 research project. Photo: NASA

So just what did the X-15s achieve in their nine years of research? Broadly, they paved the way for the development of America's manned space programme, from Mercury, through Gemini, to Apollo and the present Space Shuttle Orbiter. More specifically, the X-15s pioneered the use of reaction controls for attitude control in space; they demonstrated the practicality of atmospheric re-entry by a piloted lifting vehicle; they demonstrated a pilot's ability to function in a state of weightlessness; and developed the first practical full-pressure suit for pilot protection in space. The X-15 was the first to employ reusable super-alloy structure capable of withstanding the temperatures and thermal gradients of hypersonic re-entry and, in the design and construction stage, new techniques were developed for the machining, forming, welding and heat-treating of Inconel-X and titanium. Improved high-temperature seals and lubricants were developed, as were inertial flight data systems capable of functioning in high dynamic pressures and in space. It was discovered that hypersonic boundary-layer flow is turbulent, not laminar, and surface irregularities causes 'hot-spot' generation at high Mach numbers. For the first time, supersonic skin friction could be directly measured and it was found to be lower than predicted. These, and many other, discoveries and developments have added to man's knowledge of high-speed flight. It is likely that the new so-called 'stealth' aircraft designs will benefit from some of the data obtained from the pioneering flights of the X-15.

THE BRITISH INTERPLANETARY SOCIETY'S

PROJECT DAEDALUS

BY ALAN BOND BSc(Eng.)FBIS, PROJECT LEADER OF THE DAEDALUS STUDY GROUP



The early decades of the present century saw the transformation of an ancient novelty, the rocket, into a sophisticated mode of propulsion. The recognition of the rocket's potential led to intensive technological development and a dramatic improvement of its component efficiencies during the next half century until today, having placed man on the moon, it promises to be the only credible way for mankind to leave his native planet for the foreseeable future.

Once into Earth orbit other sources of energy may be considered for expelling the propellant mass from the vehicle; solar power from solar cell arrays or nuclear energy from compact nuclear reactors. When used in conjunction with electrical accelerators of various designs, the high velocity exhaust jets thus produced give the rocket the capability to reach anywhere within the solar system on a timescale of a few years and thus open it up for exploitation by mankind.

Of course none of the latter has yet happened to any significant degree, but we know it to be technologically feasible and, given that the World's economic growth will continue, it seems reasonably certain that the Solar System will become fully inhabited with communities and trade developing around every major resource in the system.

What then? Can we see any prospect for further expansion of this culture beyond the Solar System to the nearest stars? To date, only a single study has been carried out to any depth to try and gauge the feasibility of an interstellar mission of any type. The study called *Project Daedalus*, after a cunning Greek craftsman from mythology who escaped his prison by fashioning himself wings, was performed by a team of engineers and scientists of the British Interplanetary Society. After five years of study it was concluded that, given certain areas of technical progress, a certain type of rocket called the nuclear pulse rocket could be developed to a capability of projecting a payload of instruments on a one-way mission to the near stars.

It would require a wealthy spacefaring community to build and launch it but, as was briefly discussed above, we expect to eventually become that anyway. Thus, given that the nuclear pulse rocket enjoys the same development success of the conventional chemical rocket, it seems likely that future human generations will view with awe the close-up views of other stellar systems the way our generation has seen the planets of our Solar System.

A Rocket to Light-up the Night Sky

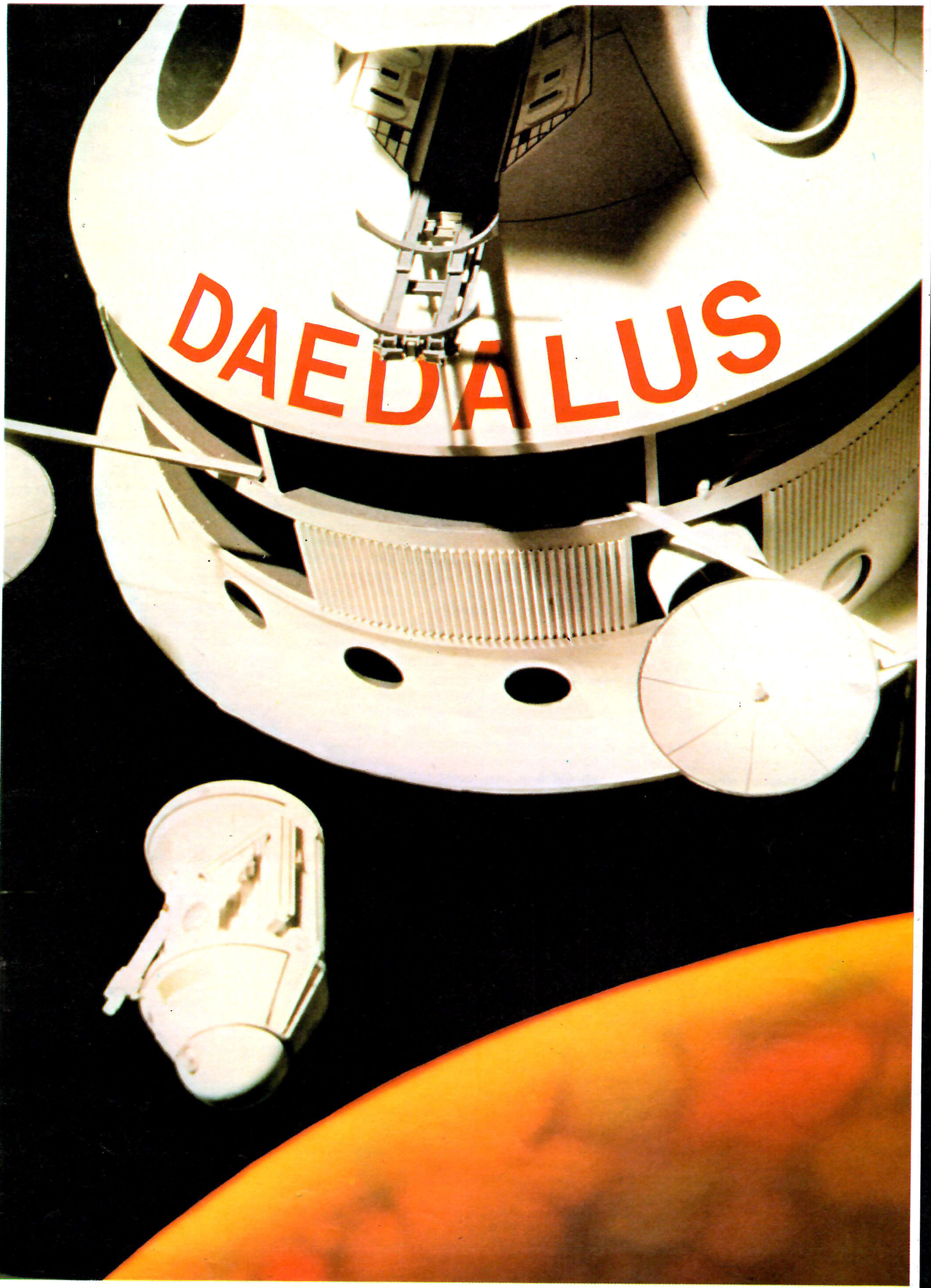
Project Daedalus began in 1973 with a range of studies to see what performance could be squeezed from the nuclear rocket. It quickly became apparent that only one contender had any prospects in the interstellar race, namely the nuclear pulse rocket. This device is simple in concept and has a history dating back to the latter half of the 1940s. The principle is simply to release a train of nuclear explosions behind the vehicle and allow the rapidly expanding debris from each detonation to 'blow' the vehicle along in a sequence of small jerks. Although this sounds very drastic, and indeed, would look very dramatic, the concept is in fact sound and between 1958 and 1965 the American Air Force funded a lot of work, both theoretical and experimental, on *Project Orion*, the results of which would have been a space battleship to match anything in *Star Wars*. Small chemically-propelled test vehicles were flown in the course of this project, and the dramatic films of these flights still exist.

Orion was never built due to the signing of the international test ban treaty on nuclear devices but it is certain that it would work. It would not be capable of interstellar flight, however, because Orion used conventional atomic explosions with each nuclear charge carrying its own detonation mechanism and relying on the energy released in the fission of uranium and plutonium nuclei. As a result the relatively low energy per unit mass of the bomb debris gave exhaust velocities much too low for such a demanding application. Orion could have gone anywhere in the solar system in a few months, but the nearest star is over 6000 times as far away as Pluto and hence out of the question on flight time. By the time the BIS study began, a new factor had emerged called 'pulsed power technology', and it is this which shows promise of increasing the Nuclear Pulse Rocket performance.

Pulse Power technology refers to the transfer of sizeable quantities of energy of, say, a few kilojoules to megajoules in the space of a few nanoseconds (10^{-9} sec) or less, resulting in peak power levels in excess of 10^{12} watts. Such devices are handling power levels equal to, or in excess of, the power output of the entire human race's activity for the short period of time. Generally the energy is invested in particle beams such as photons produced by lasers or electrons or ions generated by special transmission lines.

In principle, such bursts of power could be employed to very rapidly heat the exterior surface of a pellet of material causing the outer layers to blow off at high velocity and imploding the remaining core to very high density and temperatures. Several laboratories around the world in the USA, Russia, Britain, Japan, France and Germany have achieved such inertial confinement of material at conditions approaching those found inside stars and hydrogen bombs.

Above, the complete Daedalus craft composing two stages as illustrated overleaf. At right, the second stage of Daedalus passing by a planet in a far-off solar system with one of its wardens in close attendance.
Models and photos: Mat.


DAEDALUS

If the material of such a pellet is a suitably-chosen mixture of elements, and the temperature, density and time of compression are correct, nuclear reactions will occur in which the atoms fuse together to form heavier ones. This is called nuclear fusion and is the source of energy in stars and hydrogen bombs. If done correctly, far more energy will be liberated than it took to ignite the explosion and the possibility exists to recover the ignition energy from the expanding explosion and still leave a high exhaust velocity. Since no extraneous materials are involved in the detonation, a high energy per unit mass of pellet results, particularly since fusion reactions are several times more energetic than the fission reactions employed by Orion. It was this mechanism which the BIS chose for its starship engines.

First, the nuclear fuels selected were deuterium and helium 3. The first is a heavy isotope of hydrogen and the latter, the light isotope of helium. These were selected because the reaction produces relatively few damaging neutrons and, since the engines would need to be in operation for several years, this was a very important consideration. The engine would operate on the following lines.

A pellet of deuterium and helium 3 frozen to −270°C would be injected by a special gun into the engine. It would be aimed to pass through a target point and on arrival it would be simultaneously hit by the beams from dozens of electron beam generators, causing the pellet to be driven to ignition conditions. The surrounding engine mechanism is shown in **Fig. 1.**

A magnetic field would be provided around the target zone by an arrangement of field coils. When the pellet exploded, the resulting very hot fireball would be electrically conducting and, as it expanded, would sweep the field back and compress it against a conducting metal shell called the reaction chamber. At the same time some of the field would pass through a carefully positioned loop around the engine exit, enabling energy to be drawn off to recharge the electron beam generators for the next pellet. When the field had been fully compressed, it would stop the expansion of the bomb debris and then rebound, ejecting the material at close to its expansion velocity from the engine exit. The result would be a pulse of exhaust gas moving at 10 million metres per second, about 2000 times faster than any chemical rocket motor could achieve. The reaction chamber would experience a pulse of thrust which it is designed to smooth out slightly and transmit to the vehicle structure of the starship to give it a reasonably smooth acceleration. Pellets and explosions would follow in a rapid train, the Daedalus vehicle releasing 250 per second. Of course each explosion is relatively small being equivalent to about 80 tonnes of TNT in the Daedalus first stage engine. Such an engine would be generating more continuous power than we do on the entire Earth today and would produce an exhaust plume millions of miles long. Needless to say, the engineering problems involved in building such an engine are colossal and many advances in technology are necessary before it could be realised. However the Daedalus team tried to stay within the realms of anticipated progress and their conclusions should not be too far astray.

A Fleeting Glimpse of a New World

Despite the enormous power of the Daedalus engines, it became evident very early in the study that only a very simple mission should be considered due to the long flight times which emerged. The mission chosen was the undecellerated fly-by of the nearby Barnards Star at a distance of six light years. The vehicle would travel at 13% of the speed of light and would be in transit up to encounter for almost 50 years. At the encounter the vehicle would charge right past the star, and any planets it possesses, in the order of a day or so and the time close to any planets would be measured in a fraction of a minute. All the data collected would be transmitted back to the solar system using microwaves and to ensure its arrival, would be repeated several times for a period of about three years. The payload of the Daedalus vehicle would be fully automatic and have a mass of about 500 tonnes. It would be subdivided into experiments to be carried out during the long interstellar coast period following the four year boost from the Sun and experiments to be carried out during the encounter with the target star. The flight profile is shown in **Fig. 2.**

During the coast phase, equipment would be flown several thousand kilometres away from the vehicle to avoid its pollution of the interstellar environment. For better coverage during the encounter, the payload would deploy 18 sub-probes, some of which would have their own propulsion enabling them to make close fly-bys of any planets. Deployment would occur in two main phases, the first for the more easily detectable Jovian type planets, and the second for the smaller and less reflective terrestrial types.

During the encounter phase of the mission, it may well be necessary to redirect the scientific resources of the payload either to compensate for equipment failure or to better investigate unexpected phenomena. The vehicle would be six light years from home at this time and no rapid discourse would be possible with the vehicle. A simple question and answer would take 12 years and so the payload would require a large computer with a high level of machine intelligence and decision-making capability. It would need to make all contingency plans unaided and would be very sophisticated by today's standards. However, even now spacecraft in the outer regions of the solar systems are facing delays of up to several hours and are having to face up to their own decisions.

Another task which has to be solved without human intervention is that of reliability and maintenance. It is demanding a great deal to ask a piece of equipment as complex as Daedalus to function without failure for 50 or more years. It was proposed to solve this by carrying two robots, weighing five tonnes each, called wardens. The wardens would have sensors, manipulators and propulsion systems. They would have a large inherent computing power with microwave links to the main mission computers on the vehicle. The wardens would use plutonium radiosotope power supplies which would last the entire mission. It would be their task to locate and repair failures anywhere on the ship, including themselves and each other. In addition they would place and retrieve payloads flying at great distances during the interstellar coast period.

After a brief view of the target star, Daedalus would fly off towards the centre of the galaxy to be lost with its wardens and sub-probes. It would, however, in that brief encounter have achieved for stellar astronomy what earlier vehicles did for planetary astronomy. Other

Figure 1. Daedalus Nuclear Pulse Rocket Engine.

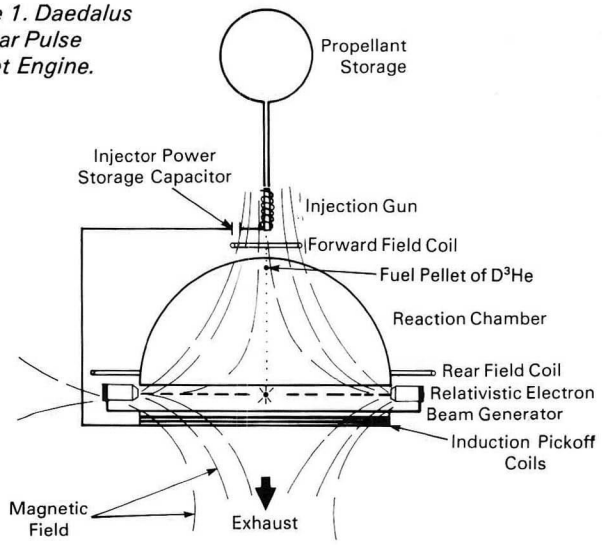
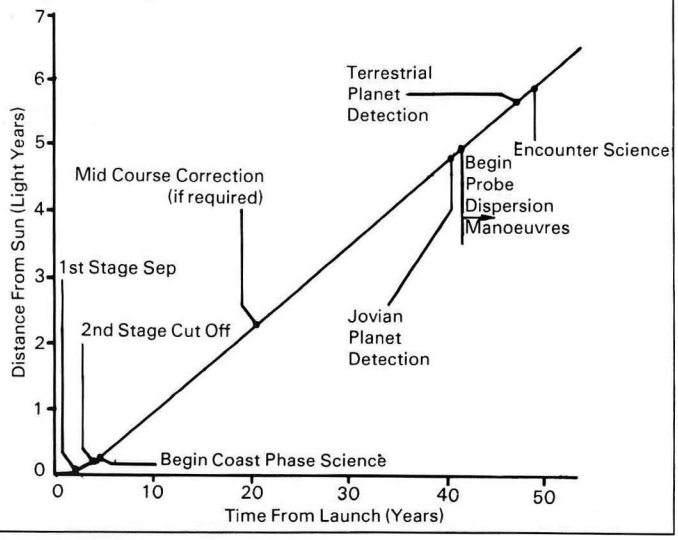


Figure 2. Flight Profile of Daedalus Mission.



vehicles would go to other nearby stars covering in all between ten to 20 of our Stellar neighbours.

Blueprint for a Starship

The Daedalus study defined in some detail the parameters of the major systems of a starship. The final BIS design was for a two-stage vehicle carrying a total of 50 000 tonnes of fuels at ignition. The structure would add a further 4000 tonnes to the initial mass. The starship would be built in Jovian orbit possibly using the satellite Callisto as a base for operations. The reason for this location is dictated by the choice of helium 3 for one of the fuels. This fuel is very rare on Earth and the inner planets of the solar system, but reasonably abundant in the atmosphere of the outer planets. Jupiter was therefore selected as being the nearest place to the Earth with all the resources necessary for this complex mission.

The first stage of the vehicle would contain 46 000 tonnes of propellants in six spherical drop tanks mounted forward of the engine hardware. The 4000 tonnes of propellants in the second stage would be carried in four drop tanks mounted in the same position relative to the second stage engine (**Fig 3** shows these stage configurations.)

The forward end of the vehicle comprises the 500 tonne payload, carrying optical and radio telescopes, equipment for measuring particles and fields and the family of sub-probes. This payload would be active from the end of boost, but, prior to that, would generally be stowed to avoid the more damaging aspects of radiation and energetic exhaust from the engines. The first stage would be under power for about two years, with two drops of redundant tankage at about eight month intervals. The second stage would follow on immediately from the first stage and would burn for 1·8 years with a tank drop after 11 months and a final drop at cut-off. The second stage would than have only 50 tonnes of reserve fuel for the purpose of manoeuvres at the target in order to place probes on trajectories passing close to planets. During the long interstellar coast the forward end of the vehicle would be subject to a continuous bombardment of dustgrains moving at 13% of the speed of light. Although the damage caused by each grain would be very slight as their mass is very small, the cumulative effect would be significant. Protection is afforded by means of a Berylium shield, having a mass of 50 tonnes, which would gradually be erroded away during the mission. As the vehicle begins encounter with the target, the density of matter in space may be expected to increase to meteorite levels. Based on the density and mass distribution of the solar system, a collision with debris weighing up to half a tonne could occur. Such an event would terminate the mission with an explosion of nuclear proportions. In order to protect the vehicle and sub-probes at encounter a shielding cloud of fine particles would be flown about 200 km ahead of each vehicle, dispersed by a small 'pepper pot'-like device called a 'dust bug'. These devices would ensure that a completely occluding cloud was always maintained so that any particle or solid body encountered would be vaporised instantly and disperse before the arrival of the vehicle a few thousandths of a second later.

After the encounter with the target star the sub-probes would relay their data back to the main vehicle for transmission to the solar system, six light years away. This transmission would use the reaction chamber of the second stage engine as a 40 metre antenna, a novel combination of functions into a single hardware component. The power for the transmission would be provided by four nuclear reactors, which would have been operating at low power level throughout the previous 50 years but would now be powered up to full power, providing some 2·6 MW of electrical power for three years whilst the data was relayed back.

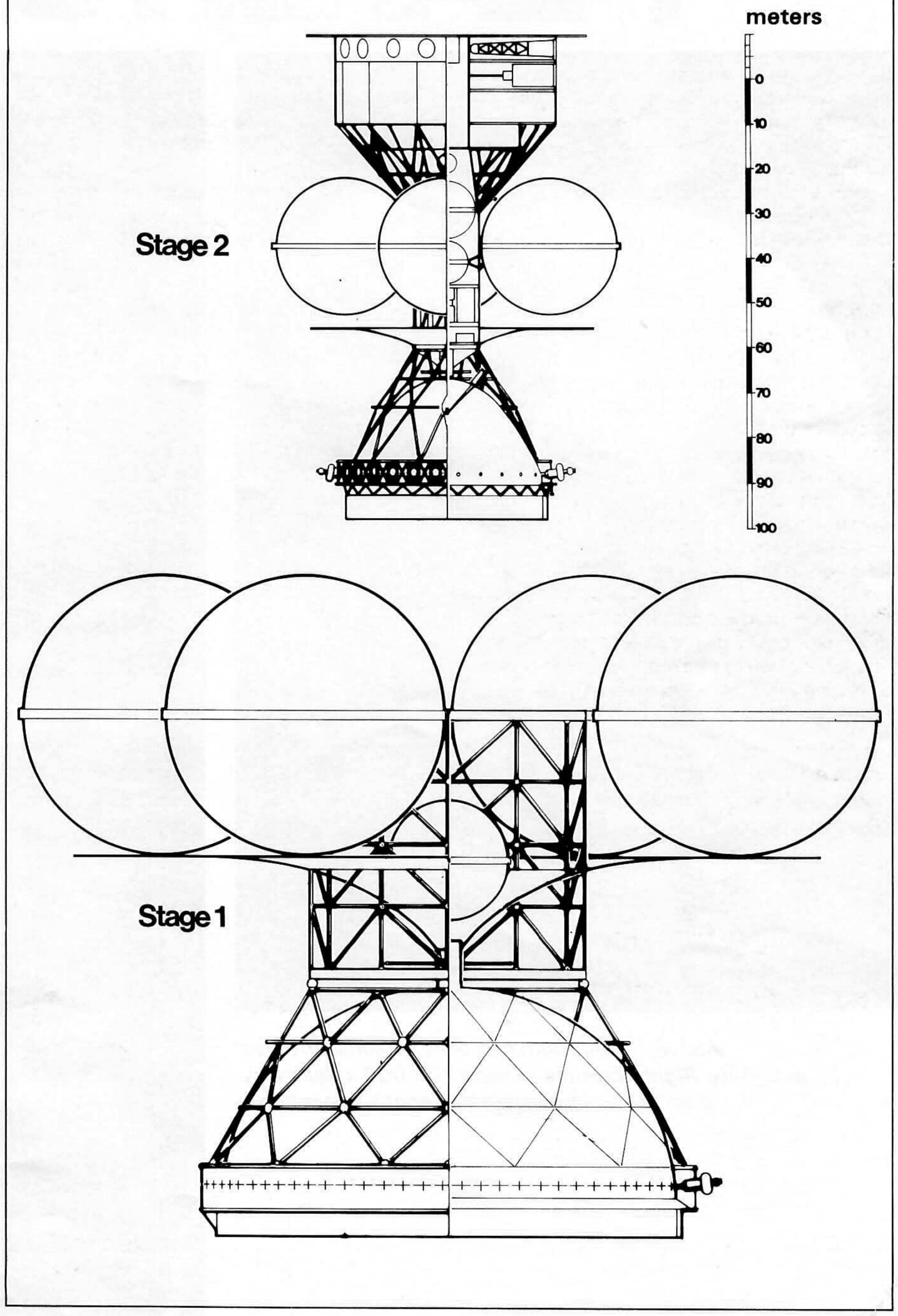
Outlook

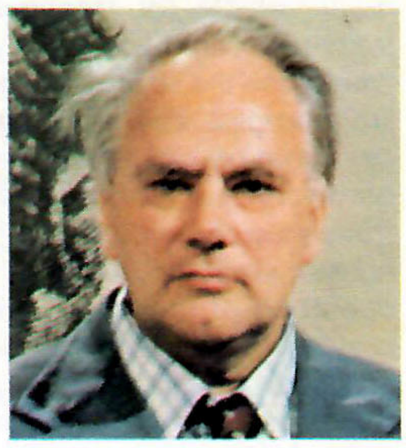
We began by seeking the prospects for interstellar flight on the assumption that the human race would master the solar system. The nuclear pulse rocket appears to guarantee that it would easily give access to every planet in the Sun's retinue. The flight to the stars is, however, difficult and the British Interplanetary Society's study suggested that in short flight times of less than a century, say, only a dozen or so stars could be explored with robot vehicles. Manned interstellar flight would require something much grander in concept, either very fast approaching luminal velocity, or very slow but huge, carrying sizable human populations having everyday life as their main goal, whilst their eccentric trajectory through the galaxy would be of secondary importance. It is impossible to guess whether anyone will want to make this semi-eternal flight. We can only suggest that, if they wished to, they probably could.

Further reading:

Spaceflight 19 419 (1977).
Martin A.R. (ed). Project Daedalus. British Interplanetary Society. (1978).

Figure 3. Both stages of Daedalus.





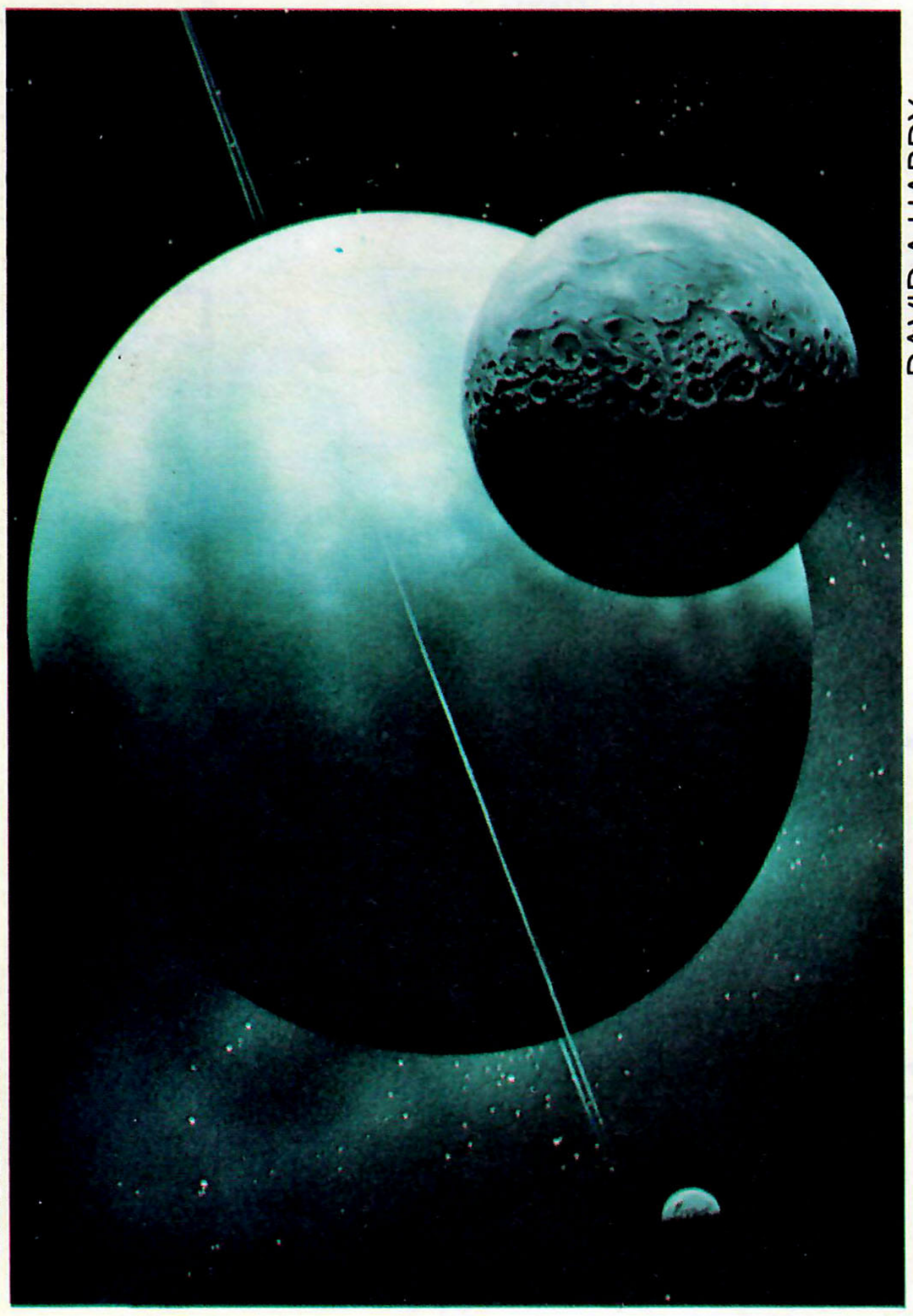
PATRICK MOORE OBE

THE CHILLY PLANETS

How would *you* feel if you discovered a new major planet? Highly elated, no doubt; but there are only three men in historical times who have had this experience. Two were German, and the other American. Their names were Johann Galle, Heinrich D'Arrest, and Clyde Tombaugh.

But, I can hear some people saying, what about William Herschel? Didn't he discover the planet Uranus?

Indeed he did – but he did not recognize it as being a planet. He mistook it for a comet which would be interesting but by no means breathtaking; comets, after all, are common enough. Herschel was not even carrying out a deliberate search. He was engaged in what he called a review of the heavens, and one night in March 1781 he came across an object which was decidedly unstellar. It showed a disc, which no star can do, and from night to night it moved slowly against the starry background. It was only a little later that mathematical calculations showed the object to be a planet,



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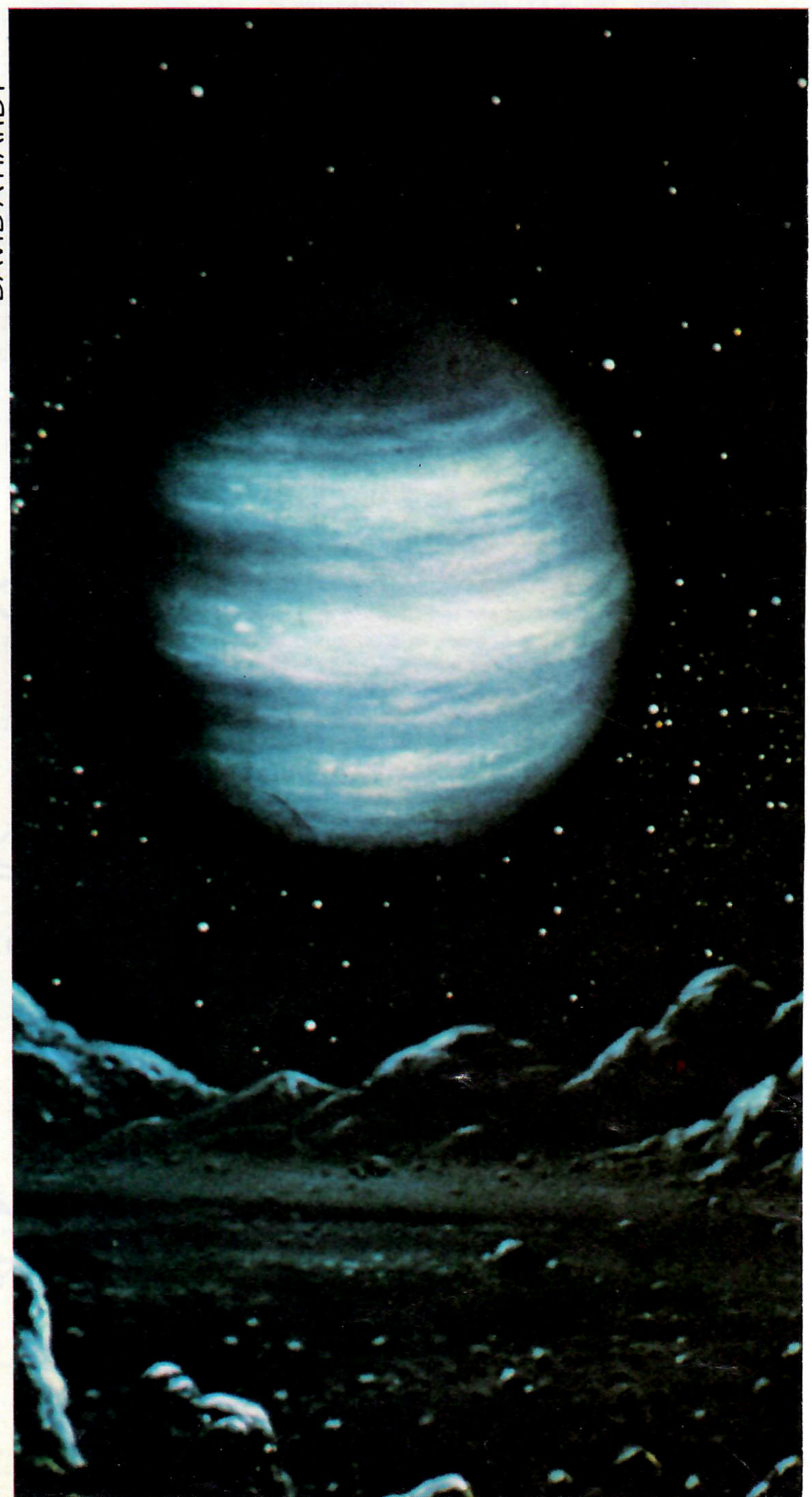


DAVID A HARDY

Above, Uranus with two of its satellites in close proximity. Right, Neptune as seen 200 000 miles away from Triton, largest of the planet's two moons.

moving far beyond Saturn, the outermost of the planets known in ancient times.

Uranus was unexpected. Even more unexpected was the discovery that it was moving in an apparently irregular fashion. Over the years it wandered away from its predicted path, and gradually astronomers came to the conclusion that it was being pulled out of position by an unknown planet moving at a greater distance from the Sun. Astronomers were faced with a sort of cosmic detective problem. The victim, Uranus, was on view; where was the intruder?

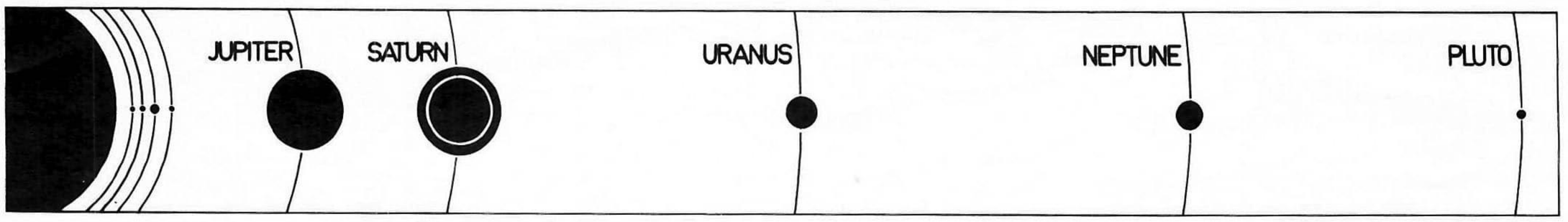
At Cambridge, John Couch Adams determined to solve the mystery. He made a long series of calculations, and by 1845 was fairly sure that he knew the position of the new planet. Unfortunately the Astronomer Royal of the time, George Biddell Airy, was not enthusiastic; Adams made no attempt to search the sky on his own account, and things drifted along. In France, Urbain Jean Joseph Le Verrier undertook similar calculations, and came to a similar result. He sent his calculations to the Berlin Observatory, and at once the astronomers there, Galle and D'Arrest, identified the planet we now call Neptune.

Uranus is just visible with the naked eye if you know where to look for it, but Neptune is much too faint. Both are giants, with diameters of the order of 30 000 miles; recent measurements show that Uranus is slightly the larger of the two, although it is the less massive. Obviously they are totally unlike the Earth. Each is believed to have a relatively small silicate core, around which is material containing ammonia, water and a great deal of the two lightest gases, hydrogen and helium. Their surfaces are gaseous, which alone makes it quite impossible ever to land there.

Uranus and Neptune have been regarded as twins, but they are not identical. One difference is that Neptune seems to have an internal heat-source, while Uranus has not. In this respect Uranus is unique among the giant planets; both Jupiter and Saturn have considerable heat-sources inside their globes, though they are not nearly hot enough or massive enough to be classed as 'minor stars', and their surfaces are bitterly cold.

Telescopes show little on either of the outer giants. Uranus has a pale greenish disc, upon which a few vague zones have been made out; Neptune is bluish, but its disc is too small to show any detail at all. Obviously, then, our knowledge of them must be limited, but it is reasonable to assume that they are less active than Jupiter or Saturn.

Uranus, moving round the Sun at a mean distance of 1 783 000 000 miles, has a 'year' 84 times as long as ours, but its 'day' is short; probably of the order of 18 hours, though no exact figure is known. The strange fact is that the axial inclination is 98 degrees to the perpendicular – more than a right angle, so that there are times when one of the planet's poles is facing the Sun. The Uranian calendar is very remarkable. Each pole has a 'night' lasting for 21 Earth-years, with a corresponding 'midnight sun' at the opposite pole. The



Simplified sketch shows (from left to right) the Sun, Mercury, Venus, Earth, Mars and the outer planets at their relative distances from each other in the Solar System. By the late eighties we should know much more about our mysterious, distant planets.

reason for this state of affairs is unknown, the axial tilt of Neptune is only 29 degrees, so that the seasons there are more conventional even though they are so long. Neptune takes nearly 165 Earth-years to complete one circuit round the Sun.

Uranus has five satellites: Miranda, Ariel, Umbriel, Titania and Oberon, which are smaller than our Moon, with diameters of 1500 miles or less (much less, in the case of Miranda), and probably all are made up chiefly of ice. Uranus also has a system of rings. They were discovered in an unexpected manner, and more or less by accident!

Uranus sometimes passes in front of a star, and hides or 'occults' it. When this happened in 1977, the star was found to 'wink' regularly several times both before and after the actual occultation, so that clearly it was being hidden by material circulating Uranus. Ample confirmation has since been obtained, and we now know that there are at least eight rings. Yet they cannot rival Saturn's magnificent system; they are narrow, and made up of darkish material, whereas Saturn's rings are composed of icy particles.

Jupiter has a ring, discovered by the Voyager probes; Saturn, of course, is superb; Uranus has eight rings; surely then, Neptune should have a ring too? This is the popular view, but I admit that I am dubious, because Neptune has a large satellite Triton, moving round in a 'wrong-way' or retrograde direction. Triton is the only large satellite to move round its primary in a sense opposite to that in which the primary is spinning, and I suggest that this must make conditions in the whole region decidedly unstable – which would argue against the presence of a ring.

Triton may be at least 3000 miles in diameter, in which case it is as large as the planet Mercury and may have an atmosphere, although as yet we cannot be certain. Neptune's only other satellite, Nereid, is much smaller, and has a highly eccentric orbit more like that of a comet than a satellite.

How can we find out more? Positive results may come from the Large Spade Telescope, due to be launched in the mid-1980s; but at the moment our main hopes are concentrated in one probe – Voyager 2 which by-passed Saturn in August 1981, scheduled to encounter Uranus in January 1986 and Neptune in August 1989.

This sort of 'grand tour', which I have rather irreverently termed 'interplanetary billiards', is possible because at the time when the Voyagers were launched, in 1977, the four giants were placed in a particularly favourable manner. (This has nothing to do with the absurd so-called 'Jupiter effect', in which it was claimed that the planets would line up in 1982, producing dire effects upon the Earth; there was no such alignment and it could, in any case, have affected nothing even if it had occurred!) But 1977 was an excellent moment to send up a multi-planet probe, using the gravitational pull of one giant to send the vehicle outward to the next. Voyager 1 encountered Jupiter first (1979) and then Saturn (1980); it was also scheduled to study Titan, the largest of Saturn's satellites, after which its main mission was over. Voyager 2 ignored Titan, and so could continue outward to the two outer planets. Of course, it would be possible to send a probe to Uranus (or Neptune) without taking advantage of this opportunity; but it would take much longer.

There was a mishap as Voyager 2 drew away from Saturn. The scan platform, carrying the cameras, jammed. Presumably a ring particle was the cause of the trouble, and for a while it seemed that the rest of the mission would be badly affected. The platform now appears to be free once more, but it would be unwise to be over-confident. The official view is that there should be a 60% chance of success with Uranus, but only 40% with Neptune; remember, too, that by the time of the Neptune rendezvous, Voyager 2 will have been travelling in space for more than 12 years . . .

We must hope earnestly that nothing will go wrong, because if Voyager 2 fails we can hardly hope to learn much more about Uranus or Neptune for many years to come. No more American probes there have been planned, and in this sort of programme the Russians seem to have lagged far behind.

If Voyager 2 does succeed, it ought to be able to send back images of Uranus which are as good as those of Mars obtained by Mariner 4 in 1965. We will at last find out what the planet looks like; we should see the belts and zones (if they exist), and we will be able to see whether there is any resemblance between the face of Uranus and those of Saturn or Jupiter. More important still will be studies of the Uranian magnetosphere, any radiation zones, and, of course, the nature of the ring system. Good views should be obtained of the satellites; I suggest that they are likely to be cratered in the same way as the icy satellites of Saturn.

The same sort of programme will be applicable to Neptune, where the magnetic field and radiation zones are expected to be more intense. Triton, too, should be studied. Whether there is a visible surface, or an atmosphere dense enough to hide the ground completely, remains to be seen.

After passing Neptune, Voyager 2 will have completed its task. Like its predecessor (and like Pioneers 10 and 11) it will never return; it will move away into interstellar space, and in the 1990s it will pass beyond the limit of the 'heliosphere', so that it will depart from the Solar System. Before the end of the century we are bound to lose all track of it. In some 340 000 years from now it may pass within a light-year of Sirius, but its fate will never be known. In millions of years from now it may still be moving between the stars, unseen, unheard and untraceable.

There remains Pluto, one of the major enigmas of the Solar System. Unfortunately, Pluto is not in a suitable position to be encountered by either Voyager and at the present time it is actually closer-in than Neptune; it has a relatively eccentric orbit and between 1979 and 1999, Neptune, not Pluto, ranks as the outermost known member of the Sun's family of planets.

Neptune, remember, was tracked down mathematically because of its effects upon Uranus. Yet even so, things were still not quite right, and there were suggestions that yet another planet might await discovery. The problem was taken up by Percival Lowell, the American astronomer who founded the observatory at Flagstaff in Arizona, and who is best remembered today for his theory that the canals of Mars indicated an advanced civilization there!

It is often said that men are remembered for their mistakes rather than for their achievements. It has been so with Lowell. Of course he was completely wrong about Mars; there are no canals, and so far as we can tell there is no life either. But Lowell was a good mathematician and a good organiser, and it was his work which led to the detection of Pluto.

Unfortunately he did not live to see it. He died in 1916, after various searches had been made. More than a decade later the astronomers at Flagstaff returned to the problem; they installed an excellent photographic refractor specially for the hunt, and engaged the services of Clyde Tombaugh, then a young amateur with no qualifications other than enthusiasm and obvious skill. In 1929 Tombaugh was installed at Flagstaff, and began taking photographs of the sky, checking them carefully to see if he could happen upon any starlike point which moved in the required manner.

In February 1930 he found what he had hoped to find: a very faint object which seemed to be far beyond Neptune. By March the discovery had been confirmed, and the announcement was made. Pluto was added to the Solar System, and Clyde Tombaugh's fame was assured.

Pluto was found very close to one of the positions which Lowell had given. It was later identified on two of the Flagstaff plates taken 20 years earlier, and also on plates taken at Mount Wilson, by Milton Humason, on the basis of rather similar calculations by W H Pickering. Yet almost at once, uneasy doubts arose. It was patently obvious that Pluto was not a giant. It seemed to be no larger than the Earth; and as improved diameter measurements were made, Pluto was found to be insignificant by planetary standards. We now believe it to be even smaller than the Moon, in which case it could not possibly cause any measurable perturbations in the motions of giants such as Uranus or Neptune – and yet it was by these very perturbations that it had

been traced. Something was badly wrong.

Originally it was believed that either Pluto might be exceptionally dense, or else much larger than the measurements indicated; the apparent disc is so tiny that it is impossible to decide exactly how large (or how small) it is. Gerard Kuiper did his best, using the Palomar 200-inch reflector, but his results were very uncertain. It was only in 1977 that some really reliable information was obtained, again more or less by accident.

The best way to measure Pluto's diameter would be to watch an occultation of a star. The length of time needed for Pluto to pass across the star would give a key to the apparent size of Pluto itself. Obviously one needs to know when such an occultation is due and this means making careful checks of the way in which Pluto moves. At the United States Naval Observatory at Flagstaff (not the Lowell Observatory, also at Flagstaff), James Christy examined photographs taken over the years, and found to his surprise that the image of Pluto was not symmetrical. It showed a curious 'bump', and Christy concluded that this was due to the presence of a relatively large satellite close to Pluto itself. It was given a name – Charon – perhaps somewhat prematurely, because for some time the separate existence of a satellite was in doubt. Then, in 1981, French astronomers at the Observatory of Hawaii obtained photographs which showed the two bodies separately. Charon really did exist.

The mass of a single body is difficult to determine; with two bodies, moving round their common centre of gravity, the task is much easier. It now seems definite that Pluto is no more than around 2000 miles in diameter, and that Charon has a diameter approximately one-third of this. Moreover, Charon moves round Pluto in 6·3 days – the same time as Pluto takes to spin on its axis: a case unique in the Solar System. Very probably both bodies are made up largely of ice.

These revelations have led to some drastic re-thinking. Pluto must be dethroned from its planetary status. It is more likely to be in the nature of a double asteroid or minor planet. Moreover, it may not be unique. In 1977 Charles Kowal, at Palomar, discovered a small world, Chiron, which may be at least 400 to 500 miles in diameter and moving mainly between the orbits of Saturn and Uranus. Can Pluto-Charon be of the same nature as Chiron? It is at least possible, and there may be many more minor bodies in those remote reaches of the Solar System.

I must, I think, digress to say something about Bode's Law, a famous mathematical relationship linking the distance of the different planets from the Sun. It was formulated in the 1770s, and works reasonably well out to Uranus; but it breaks down completely for Neptune – and of course for Pluto, so that in my view it is likely to be nothing more than chance coincidence. But there have been suggestions that Pluto used to be a satellite of Neptune, and that something unusual happened, twisting Triton into its present retrograde orbit and breaking Pluto free to move off independently. This is not impossible; but the discovery of Charon seems to cast serious doubt upon it. It would be hard to accept the existence of a satellite, of a satellite, of a satellite.

Let us admit that the Lowell mystery remains unsolved. The popular view is that the correct prediction was due to sheer luck. I admit that I am sceptical; it would be an amazing coincidence by any standards. It is surely more probable that Pluto was not the planet for which Lowell was hunting, in which case the real Planet X is still undiscovered.

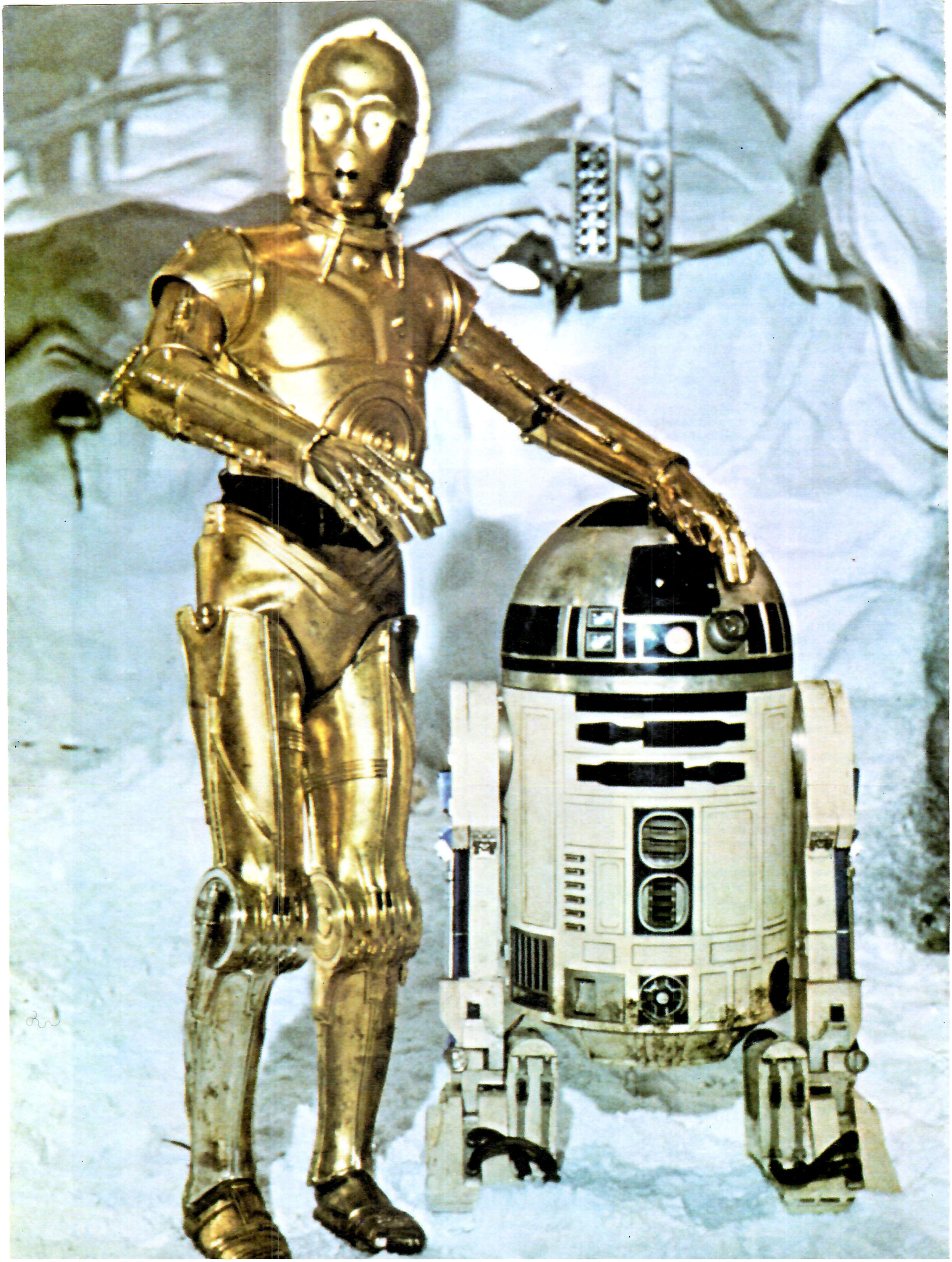
Unfortunately we have no idea of where it may be, if it exists at all. It is bound to be very faint, and to search for it would mean using up all the observing time on a large telescope over a long period – which will certainly not be attempted. Therefore, Planet X will come to light only by a piece of good fortune.

Pluto reaches perihelion in 1989. After that it will start to move outward from the Sun once more; for most of its long 'year' (248 times the length of ours) it is much more remote than Neptune, and until a probe is sent to it we are unlikely to find out a great deal more about it. It must be a gloomy world. True, the Sun would appear much more brilliant than the full moon does to us, but the cold will be intense even when Pluto is at its closest. There seems to be a very tenuous atmosphere; there may be oceans of liquid methane on the surface, but that is about all that we can say. From one hemisphere Charon would loom large but dim in the sky; from the far hemisphere, Charon would never be visible at all.

These cold, distant worlds have a fascination all their own. Until recently our information was hopelessly scanty. Today we have at least a reasonable expectation of learning more about Uranus and Neptune; one day we may solve the mystery of Pluto. One thing is certain. Each planet has provided us with plenty of surprises; the radiation zones of Jupiter, the billiard-ball smoothness of Europa, the sulphur volcanoes of Io, the amazing complexity of Saturn's rings, the nitrogen atmosphere of Titan, the huge cater on Mimas . . . the list seems endless. No doubt Uranus, Neptune and Pluto will not disappoint us. We can only wait and see.

DAVID A HARDY

A view from Pluto as envisaged by the artist. From this frigid planet, the Sun appears as a bright star reflected in a 'sea' of liquid methane – a most inhospitable environment.



Right, technicians work on R2D2 clones. Extras are vital to ensure against malfunction during production filming. Far right, one of the Millennium Falcon *miniatures gets the airbrush treatment.*
Below, full-scale Falcon *and* X-Wings *fill up the giant studio at Elstree, where production has now started on the third film. Foot, an anxious C3PO follows Han and Leia to the* Falcon *in an exciting scene from 'The Empire Strikes Back'.*

ALAN McKENZIE, EDITOR OF 'STARBURST' MAGAZINE, TAKES A RETROSPECTIVE LOOK AT 'THE EMPIRE STRIKES BACK.'

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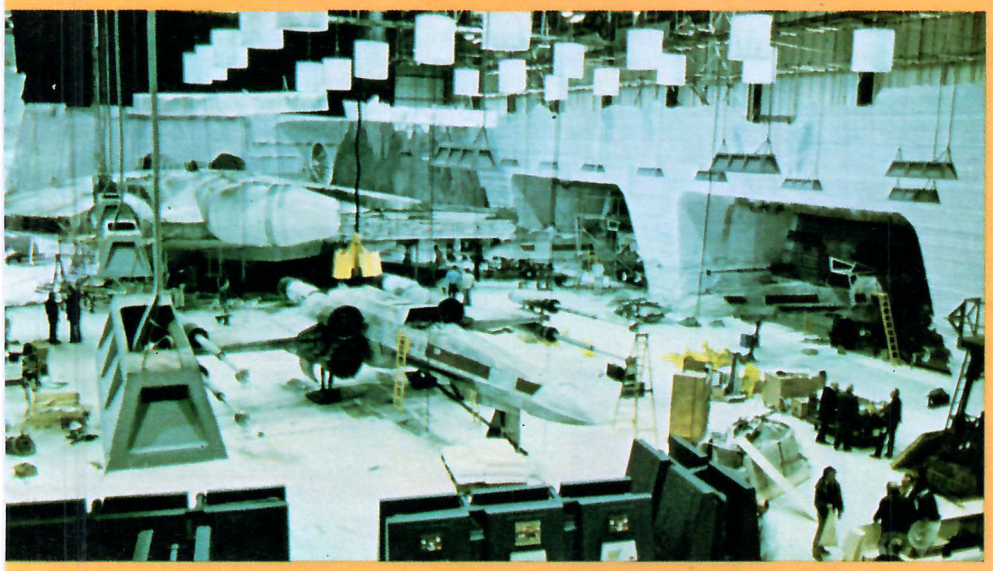

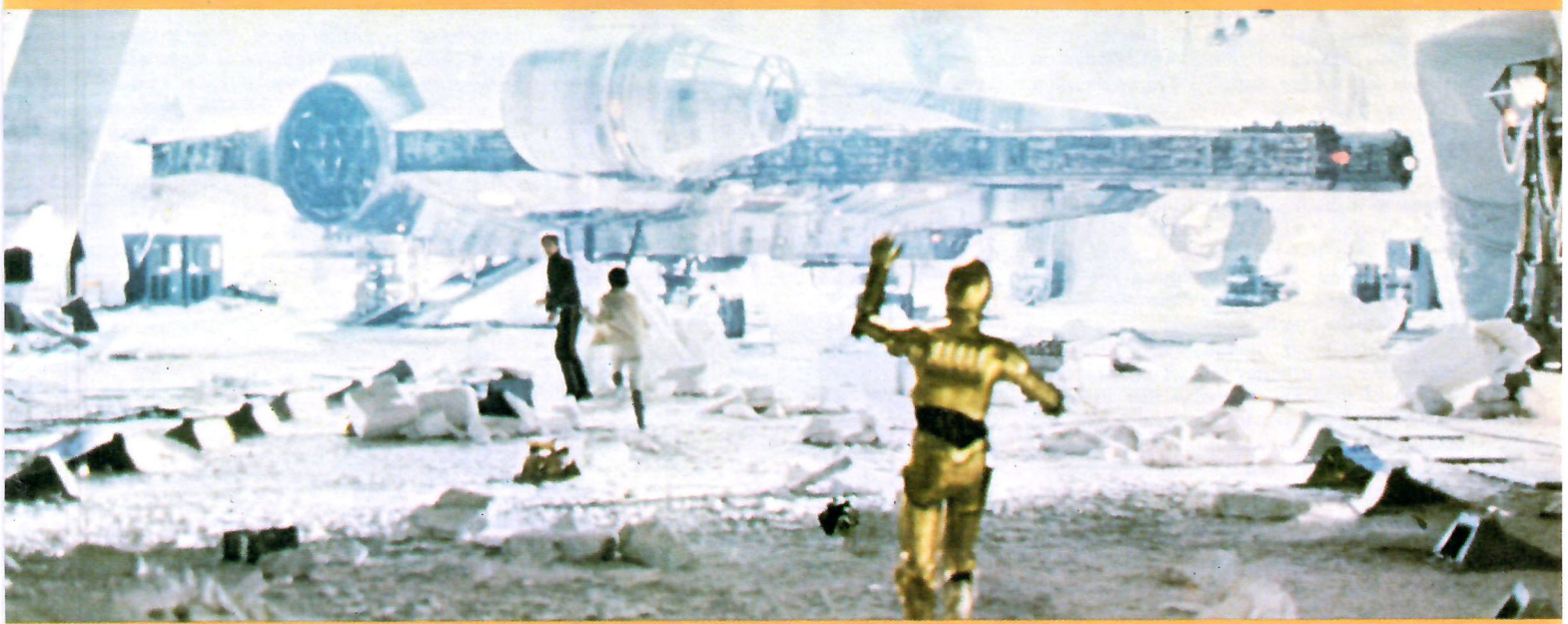

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It is now almost two years since the unveiling of the second of George Lucas' chapters in the epic *Star Wars* saga. Or, more correctly, the fifth. Like its predecessor, *Star Wars Part IV: A New Hope, The Empire Strikes Back* was filmed mainly in Britain at the Elstree complex. The alien worlds of Hoth, the ice planet, and Dagobah, the jungle world, were constructed with meticulous attention to detail within the closed doors of a specially-built, hangar-sized soundstage at Elstree. And though it measured 250ft by 122ft and was 45ft high, still the film-makers were not satisfied. So they added another 30ft to it!

But for all this, the production was plagued by a series of small, but annoying, hitches which began, strangely enough, on the first day of shooting – March 5, 1979.

Director Irvin Kershner, the cast and an army of technicians, set up their equipment on a windswept glacier in Finse, Norway to film the opening battle between the soldiers of the rebel alliance and the forces of the *Empire* on planet Hoth. Understandably, it was cold. Very cold! So severe was the weather that the entire *Empire* entourage was snowed in. An avalanche of epic proportions crashed down from the Norwegian mountains and came to rest on the railway line between Finse and the outside world. But, professionals to the last, the cast and crew refused to be defeated. After long delays, they finally managed to get their shots according to the script and wrapped. Late. Which was, in one way, something of a blessing. Why? Because of the fire . . .

Shortly before the successful completion of shooting on that icy plateau in Norway, Stanley Kubrick was at Elstree, filming the last batch of scenes for his horror film, *The Shining*. Stage 3 had been converted into the Overlook Hotel and Jack Nicholson and Shelley Duvall were chasing each other around with axes and shouting a lot. Then, on the night of January 24, 1979, Stage 3 disappeared in a puff of smoke. Burned to the ground. The Lucas lads had planned to move into stage 3 as Kubrick *et al* packed up and left. Not now. Kubrick was forced to rebuild his set on another stage and carry on. This meant that, in practice, *two* stages had been effectively removed from the Elstree books. The *Empire* team was in trouble. A second unit was brought in to speed things up. *Star Wars* production designer John Barry was assigned as second unit director, after, alledgedly, falling out with Stanley Donen on his first solo feature, *Saturn 3*. Two weeks after starting, Barry was struck down with a mysterious ailment and died. But, schedule or not, the *Empire* team closed down for a day to attend the funeral of their co-worker, a fitting tribute to a great talent. But the second unit was left without a helmer. Producer Gary Kurtz stepped into the breach for a while. Then director Harley Cokliss was signed. The situation eased, and the *Empire* team was able to get on with the task of shooting the movie.

The production, though a sequel to *Star Wars*, boasted a larger budget and a higher degree of technical expertise. For example, unlike the spaceship for the earlier film, the *Millennium Falcon* was actually a full-sized model, weighing more than 40 tons, built by an engineering firm in Wales. When it was finished it had to be divided into 16 component sections before being transported to the Hoth set at Elstree. Once there, it was reassembled, fitted with compressed air cushions and floated into position.

Meanwhile, the other, smaller models of the *Millennium Falcon* were being manipulated by the special effects team at the Industrial Light and Magic workshops in Marin County, California – more than 6000 miles from Elstree.

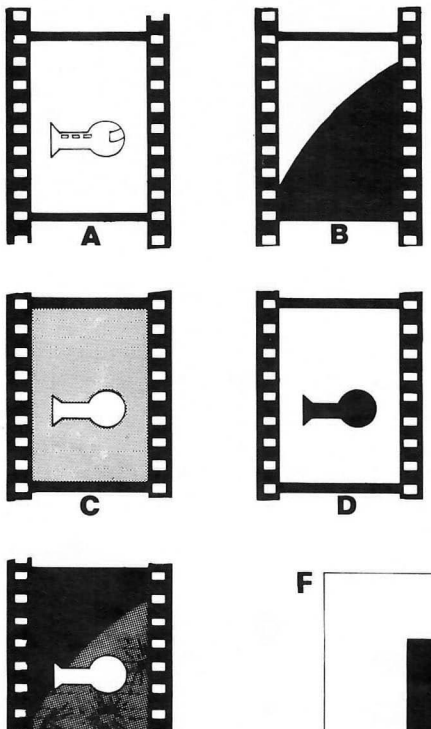
The special effects were supervised by two men – Richard Edlund, who was in charge of all photographic effects, and Britisher Brian Johnson, who took care of the physical effects.

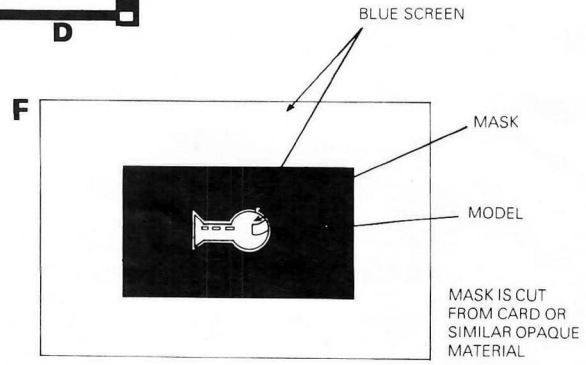
Edlund began his association with special effects through the medium of television. He worked on the optical effects of such landmark American TV shows as *The Outer Limits, The Twilight Zone* and that perennial favourite, *Star Trek*. After a spell as a freelance stills photographer, he returned to the world of the moving picture when he joined the effects firm of Robert Abel Associates. Edlund joined the *Star Wars* effects unit, Industrial Light and Magic, in 1975. After *Star Wars*, ILM turned their talents to producing the effects for the US TV show *Battlestar Galactica*, until supervisor John Dykstra quit the series and Universal Studios established their own effects unit. Edlund then worked on the miniature photography of *The China Syndrome* before being signed to supervise optical effects on *Empire*.

Certainly, there were a greater number of memorable effects moments in *Empire* than there had been in *Star Wars*. Scenes that immediately spring to mind are the battle with the Imperial Walkers on the planet Hoth, the Taun-Tauns and the flight of the *Millennium Falcon* through the Asteroid belt. When questioned about the latter sequence in the American magazine *Cinefex*, Edlund stated:

. . . *"It was a building process. One of the key shots in that sequence featured the Falcon wheeling its way through this field of flying rocks; and in order to pay off the idea they have a real rough row to hoe, we wanted to have one of the TIE ships that's following it crash into an Asteroid. So there's a lot of activity going on, and each of the elements – including the separate pieces of rock – all needed to be shot individually. Normally you start by programming out the most important compositional element in the shot first, which, in this case happened to be the largest Asteroid. So we shot that, and then we went to the Millennium Falcon swerving round it – knowing that at a later time the animation department would put a shadow across the surface of the rock to tie it all together. Then came the TIEs. The TIE ships are all pretty much anonymous, but nevertheless, they're there, so once we had the rock and the Falcon flying past it, we programmed and shot each of the TIEs separately. So we had the first TIE flying through, the second TIE flying through, and the third TIE flying through. But at this point in the composition we wanted the third TIE to collide with an Asteroid, so we then programmed in the rock that the third TIE would collide with it and flew it into the scene. As each individual element is programmed, we shot a black and white test that we can process right there on the spot to preview the move. Since it's negative film stock, the image is positioned against a clear background. Therefore we can multipack up to six or eight of these tests in a custom viewer and check all the elements at once to make sure everything's fitting together right. Assuming it is, we can then start filling in the composition. In this case, we added quite a few more rocks to make the Asteroid field look really dense. Then, to make it even more precarious-looking, we had some of the rocks flying in one direction and some in another. Then, there were three background paintings of more rocks that were filmed with a multiplane technique – and, of course, a star field. So by the time you've got four ships, 10 or 12 separate rock elements, three background paintings, a star field, plus miscellaneous explosions and shadows and lasers, you wind up with, maybe, 25 separately photographed pieces of film each of which has to be broken down into colour separations and each of which has to have all the intermediate bluescreen steps to extract mattes. So, all together, you have maybe 125 pieces of film involved. And I'll tell you, the poor guy who runs the optical printer has really got to love his work, because he has to put it all together and make sure the colour balance is just right and all the matte lines are gone. That particular shot had to be put together four times to get it just perfect . . ."*

The end result was certainly worth all the trouble – few would argue with that. But an





equally impressive sequence was the battle for the planet Hoth. Indeed, all the effects scenes set on the ice planet were impressive, mainly as similar sequences had never before been attempted in the movies.

To appreciate the achievements of the effects team one must first appreciate that the idea of ships flying through space is not a new one. Douglas Trumbull performed the trick for *2001, Silent Running* and *Close Encounters.* The *Star Wars* effects wiz, John Dykstra, achieved the same effects in *Star Wars* and *Battlestar Galactica.* The truth is that, superimposing, (or "matting") a spaceship into a starfield (*ie, black* background) has been possible for some time. Matting a spaceship – or anything else for that matter – into a *pale* background is a whole different ball game.

The matting process is a complex one, but has been refined with the advent of new technology, introduced during the filming of *Star Wars.* Simplified, the process goes something like this: a model spaceship is placed in front of a blue screen, (pale blue is invisible to monochromatic film). The model is filmed using colour film stock which results in a negative image as shown in **Fig C.** From this negative, a positive monochromatic print is taken (**Fig D**). This image is then placed, with the colour negative (**Fig B**) of the background, into an optical printer, a device for combining two or more pieces of film into one piece. The resulting composite is exposed onto a piece of colour film. The result is the background image with a transparent silhouette of the spacecraft superimposed on it (**Fig E**). A positive print of the space ship (**Fig A**) is then placed with the background/transparent silhouette film in the optical printer once more and a master negative is taken. The final positive print will show the spaceship against a starry background, and no stars will shine through the spacecraft.

The big disadvantage with this method, and the reason why it was discarded for *2001* in favour of hand-painted mattes (a long painstaking method), is that often a blue fringe, known as a matte-line, can be discerned surrounding the model. The effect is ugly and, more important, unconvincing. The matte-line can be caused several ways. Either the matte is the wrong size, caused by movement in the optical printer, or perhaps the two pieces of film being combined can move in relation to one another, or even be out of synchronisation with each other. The *Star Wars* effects technicians overcame the effects by cutting down the amount of light emanating from the blue screen. They achieved this by cutting a mask an inch or so bigger than the model being filmed (**Fig F**). This reduced the glare from the screen and thus reduced the possibility of a matte-line. Couple this with the advances made in optical printer technology since *2001* and there you have it.

However, we still have the problem of matting spacecraft (and Imperial Walkers and Taun-Tauns) into a white field. An attempt at this had been made during the filming of *Star Wars* – with less than satisfactory results. You may be able to recall the scene when the *Millennium Falcon* takes off from the Mos Eisley spaceport, flying against a pale sky. The blue fringes around the ship looked horrible. But the Empire effects team were faced with filming a long sequence involving all manner of craft matted into a *pale* field. Blue fringes were clearly unacceptable. The problem had to be

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solved. And solved it was.

Richard Edlund is hesitant to explain exactly how the matting was done. The nearest he ever got to revealing his secrets was when he admitted that the lack of matte-lines was due to increased technology and proficiency with the blue screen process; in his interview in the American magazine *Cinefex:*

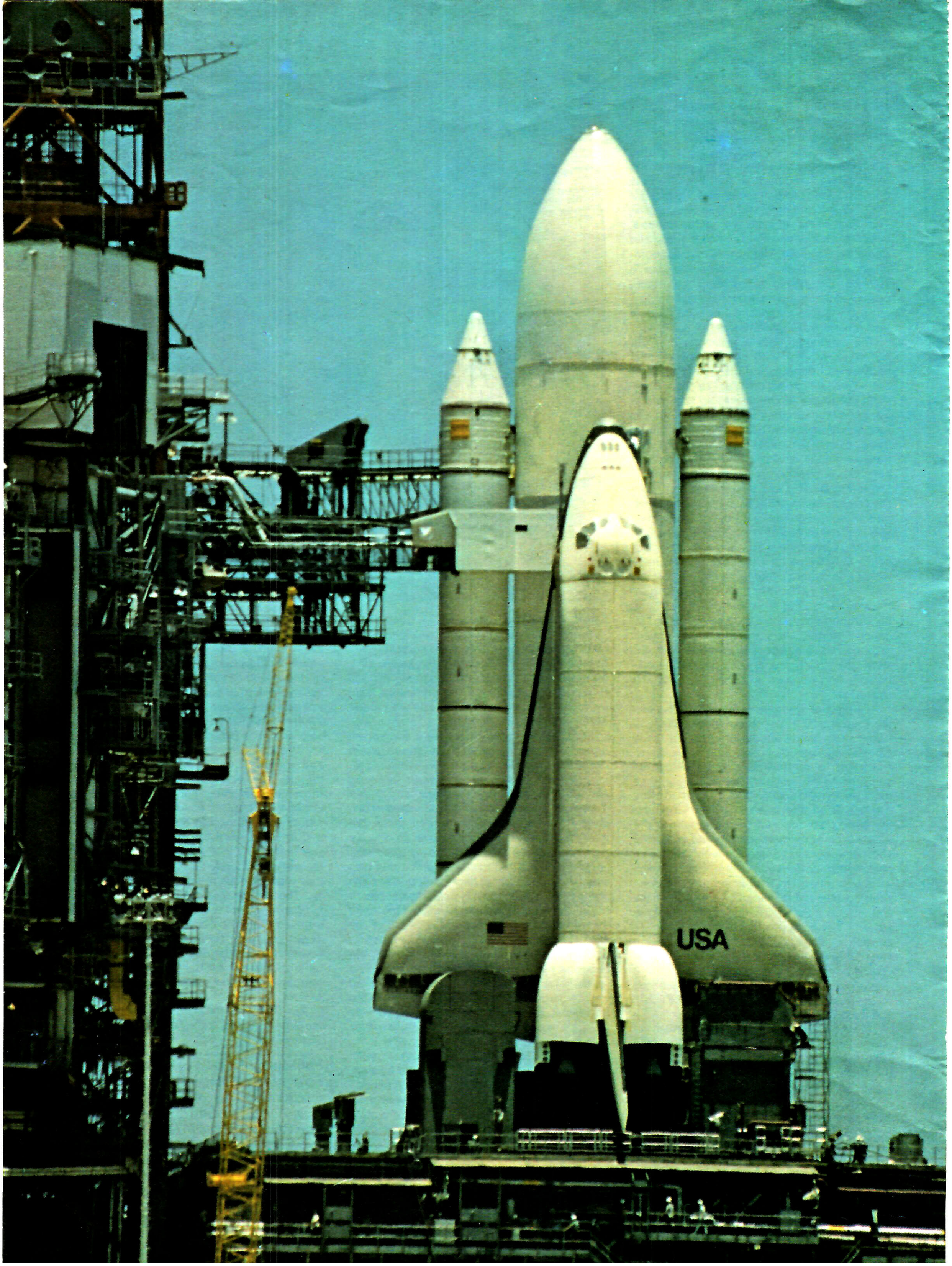
"For Star Wars we developed a fluorescent bluescreen that functioned on direct current rather than alternating. Therefore we could do high speed photography without worrying about flicker problems. I may be wrong . . . but it was certainly the first large scale bluescreen done with direct current fluorescent bulbs. We made refinements on it for Empire, so now we get a better blue, but it's basically about the same. The system for mounting the ship was something I developed back on Star Wars. We use a neon pylon which is colour balanced to the bluescreen so we can eliminate the need for rotoscoping the mounting rods out of the shot. We refined that a bit too; but not much."

The mounting rods referred to are the supports which hold the model in place. The model is held steady and the camera is moved in order to give the illusion of movement in the final result. This contributes to the singular lack of 'jiggle' when combining two or more pieces of film in the optical printer.

The Taun-Tauns and Imperial Walkers, seen in the Hoth sequence, were achieved by stop-motion animation. The same effects had been used by the late Willis O'Brien on the original *King Kong* and by acknowledged stop-motion master, Ray Harryhausen. Briefly, stop-motion involves the use of an articulated puppet which is filmed, one frame at a time, with the puppet being moved very slightly between each frame. The drawback with this effect is that, all too often, the end result is a kind of staccato movement called 'strobing'. When a naturally-moving object is filmed, it is still in motion when each of the 24 frames in a second's worth of film is exposed. The effect is that each of the resulting images is slightly blurred. When the film is run through a projector, the image on the screen looks smooth and natural. When each of the 24 frames in a second of stop motion is exposed, the puppet is stationary in each of the frames. The image is clear and sharply in focus. Run that piece of film through a projector and you get a kind of jerky movements-strobing. For this reason, George Lucas was wary of using stop-motion techniques on *Empire.* But animators, Phil Tippet and Jon Berg, were also aware of this problem, and unlike Ray Harryhausen, who still works the same way today that he did 20 years ago, they were anxious to improve the state of the art. The answer was simple. Ensure that the puppet is in motion when a frame of film is exposed. But, once again, a veil is discreetly drawn over the 'how' of the process. When asked by journalist Paul Mandell in a recent issue of *Cinefex* exactly how the blurs were introduced, Tippet replied darkly, *"It's a secret!"*

But then, like the conjuring trick, if we all knew how it was done, it wouldn't be magic would it?

Publishers' Note:
Fans of the George Lucas saga will be interested in the official Star Wars fan club. For more details, send an SAE to Star Wars Fan Club, PO Box 284, Maldon, Essex, CM9 6EY. The club serves as a forum of communication for fans of all ages – not just for adults; not just for children . . .


USA

SPACE SHUTTLE
-THE DREAM BECOMES REALITY

MAT IRVINE

Left, the dream. The test Orbiter* Enterprise *on Launch Complex 39's pad A in May 1979, the first time the complete configuration had been erected and moved to the pad. Below, the reality. Orbiter* Columbia *sits on Rogers Drylake Runway 23 at Edwards AFB, California, after a successful return. Right, Earth as seen from* Columbia *at an altitude of 130 nautical miles.

I cannot remember breathing for a full 15 seconds either side of the launch. There was this ungainly conglomeration of spaceship and booster sitting on the launch pad, about to take to the skies for the first time.

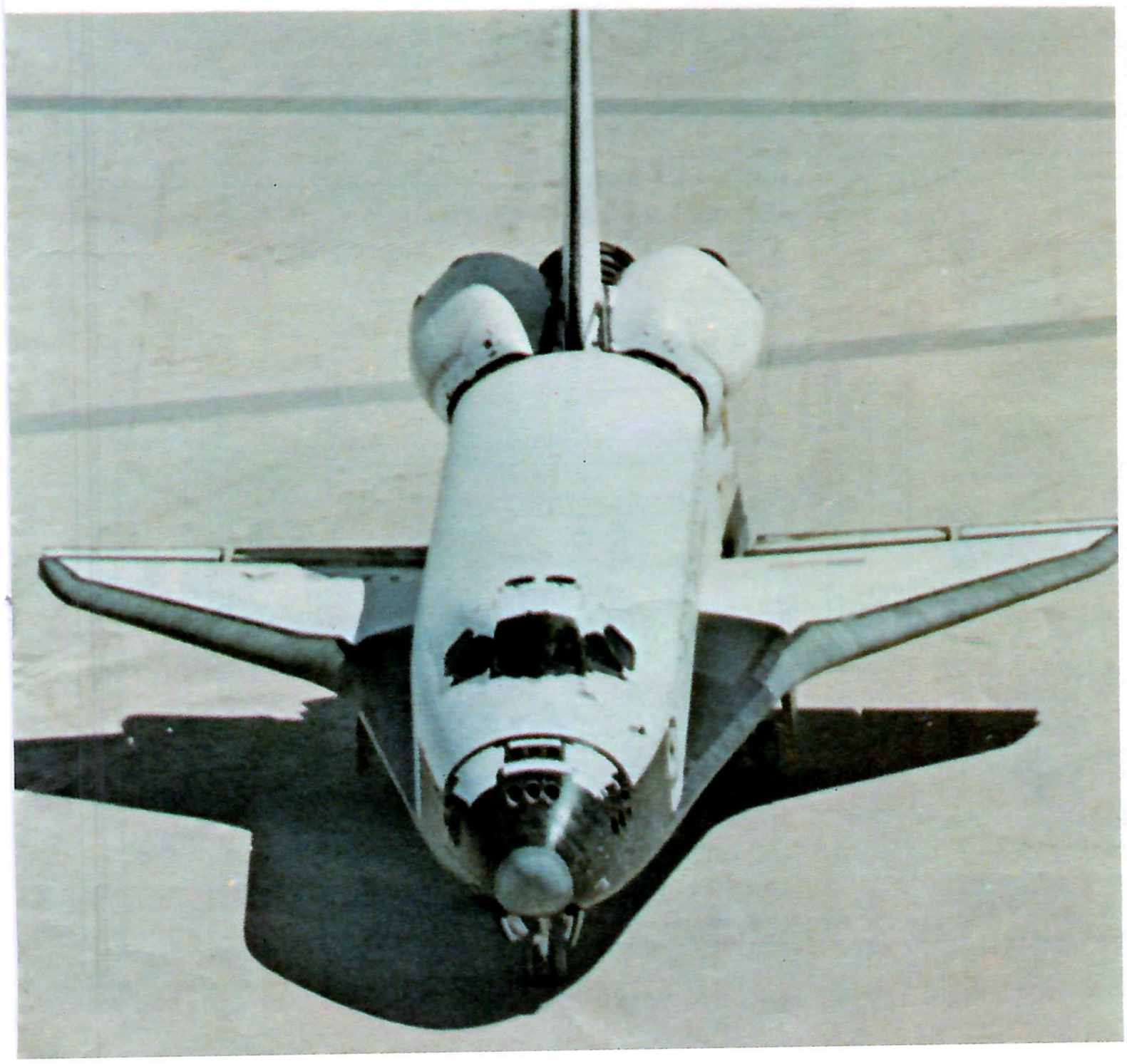
It hadn't happened before – launching an untried rocket with astronauts aboard. All previous boosters – *Mercury, Gemini, Apollo;* and presumably, *Vostok, Voshkod* and *Soyuz* had all been tested before being man-rated. Not the Space Shuttle. The computers said she would fly, coupled, I suspect, with a certain amount of human intuition, but John Young and Bob Crippen still had the dubious honour of sitting in the top of a potential unknown quantity.

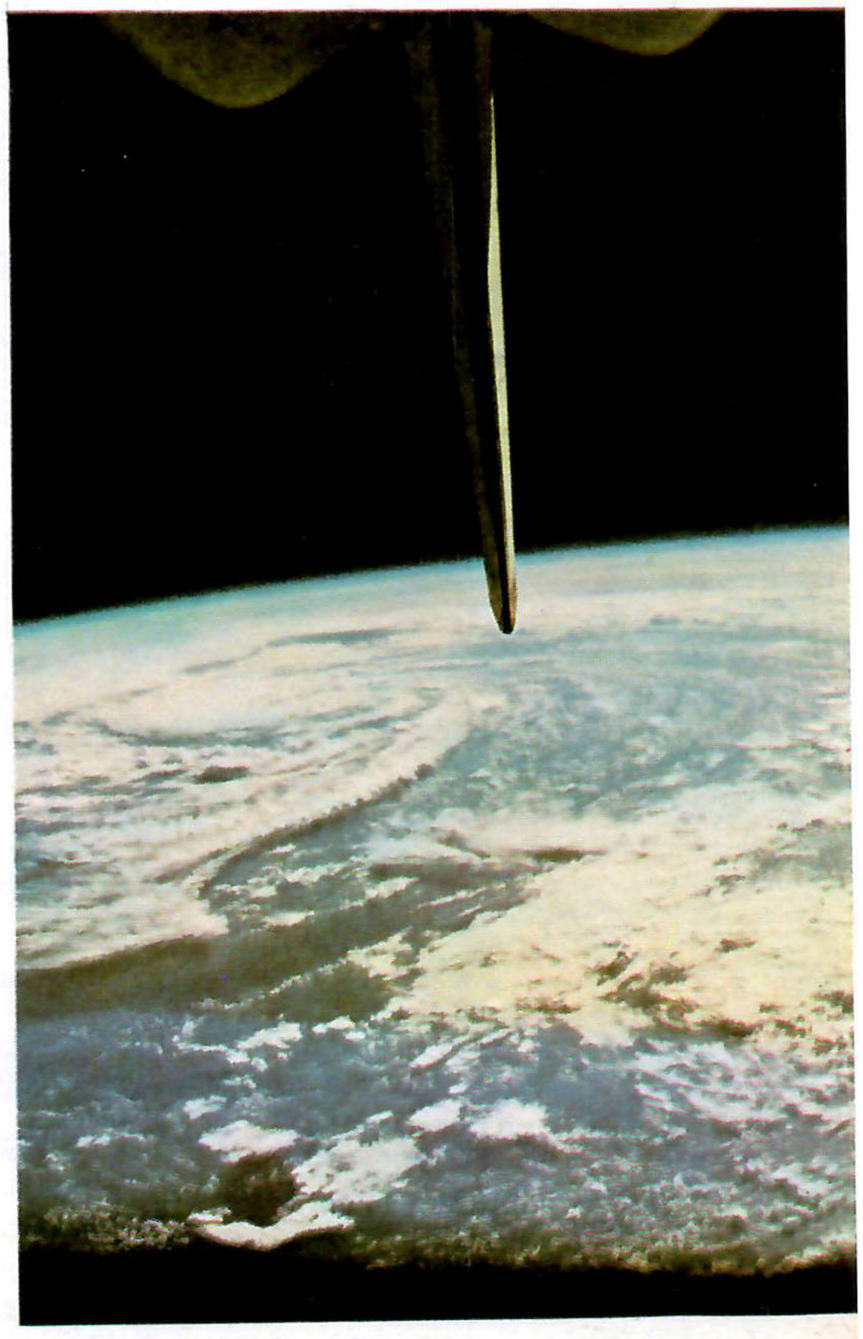
And so the seconds ticked away, going much faster than they should, and all of a sudden the SSMEs were firing, flexing the whole complex over 26", only to have their glare taken over when the gigantic SRBs fired. No build-up of power as happened with the Saturn rockets; it's all there immediately. A mere half second, the eight hold-down bolts fired and *Columbia* was away, passing the top of the tower and already travelling at 70 mph.

The roll was accomplished almost immediately the complex was clear of the launch pad, putting *Columbia* underneath the Boosters and then the Shuttle rapidly climbed out of sight, with even the radar-controlled TV cameras having difficulty in following the incredible acceleration. But they held onto the image until the SRB separation, at a height of 27 miles, downrange 25 miles, and now travelling at nearly 3000 mph.

Then it was back to the radio transmissions to find out that orbit had been successfully achieved and they were cleared to proceed with the first part of the mission.

The return was, in many ways, more nerve-wracking. That some of the tiles had become detached was obvious from the TV images of the tail area, where in fact they mattered least, but what if they had come loose on the undersurface where they were of prime importance? There was no way of checking to be absolutely positive. Highly sensitive infra-red cameras viewed the undersurface of *Columbia* as she travelled in orbit .





Photos: NASA

But *Columbia* had to return and from the moment of the de-orbit burn from the OMS engines, to tilt her back into the atmosphere, she was committed. What makes any re-entry even more harrowing is the radio communications blackout that occurs due to the build up of ionised gases around the craft. These prevent any signals getting through to the ship and so nobody on the ground has any idea of what is happening. This lasts, with the Shuttle, nearly 13 minutes while the speed of the Orbiter is reduced from 17 000 mph to just over 8000. By the time communications were regained, *Columbia* was still 34 miles away from Edwards Air Force Base, but at least everyone knew she and her crew were OK. Cameras had also now locked onto her, revealing the uppersurface as she manoeuvred round in a wide turn to line up with runway 23.

Then she was there at the end of the runway, nose up, undercarriage being lowered, surrounded by the tiny Northrop T38 'chase planes' recording her every move. Main wheels touched, still with the nose in the air, then, ever so gently, the nose lowered to put all three landing gear on *terra-firma,* the split rudder/air brake opened, *Columbia* glided to a halt and there was silence for a split second. *Enterprise* had done this before, but it wasn't really the same, *Enterprise* hadn't been into orbit and *Columbia* had.

So NASA knew they could fly a spaceship into orbit and bring her back, but the whole idea of the Shuttle is reusability, so in many ways the curtailed second flight last November was even more important. Joe Engle and Richard Truly knew they were sitting on top of, not an untried spaceship, but a second-hand one. The launch delays and shortened mission are now a matter of record, and in many ways unimportant, but when *Columbia* touched down at Edwards for the second time, that was the point when NASA knew a second-hand spaceship could be used, and the World had its first re-usable Shuttle Transportation System.

The way ahead

Some will ask, 'was it all worth it'? To those I say, if you're asking such a question you probably won't be interested in an answer anyway. *Of course* it's all worthwhile, if one has any interest in finding out more about ourselves, the tiny Earth we live on and the great expanse surrounding us on all sides. Man can either sit at home and stagnate or he can explore. The spin-offs are enormous, both practically and scientifically, but one has to invest in the future to get any returns from it.

True, the billions spent on the space programme could have been used for starving millions, but they wouldn't have been anyway and the costs are but a fraction of the amount spent on military wares. The quietly circling satellites constantly mapping the Earth's resources have returned a wealth of data, far out-stripping the space budget, the only sad fact probably being that those countries which need the information most, perhaps haven't used it to their best advantage; but that's the fault of the politicians, not the space programme. Admittedly, the Shuttle will be used to launch military payloads, but this must not be allowed to negate the positive side of Earth resources study and scientific research.

The Earth *needs* a shuttle system and with *Columbia* we have a start. It's now getting to be a hackneyed simile, but it's true; the Shuttle now is where the Wright Brothers' Flyer was only 75 years ago – think what the possibilities are for 2050.

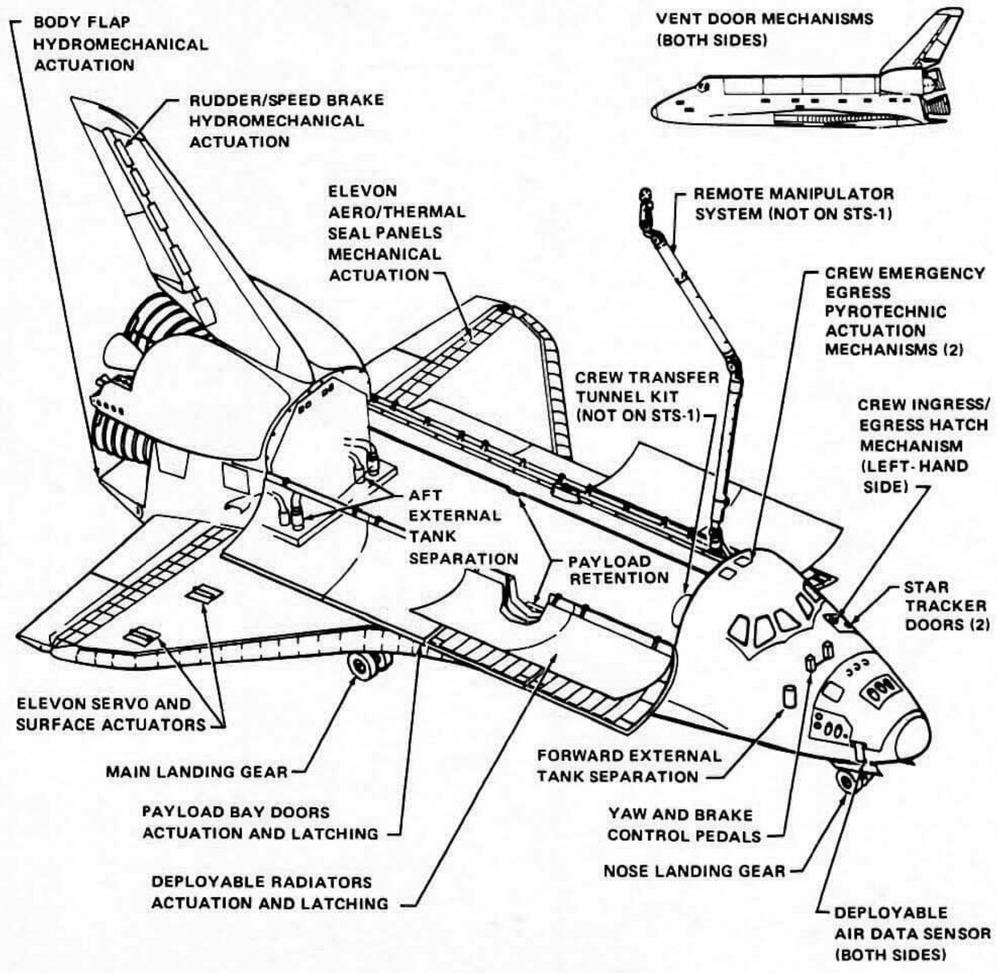
Opposite, a key payload is Spacelab, a multi-purpose laboratory that will enable scientists to conduct tests in a gravity-free environment.
Illustration: Rockwell International

SPACE SHUTTLE TYPICAL MENU*

DAY 1	DAY 2	DAY 3	DAY 4
Peaches (T)	Applesauce (T)	Dried peaches (IM)	Dried Apricots (IM)
Beef patty (R)	Beef jerky (NF)	Sausage (R)	Breakfast roll (I) (NF)
Scrambled eggs (R)	Granola (R)	Scrambled eggs (R)	Granola w/blueberries (R)
Bran flakes (R)	Breakfast roll (I) (NF)	Cornflakes (R)	Vanilla instant breakfast (B)
Cocoa (B)	Orange-grapefruit drink (B)	Orange-pineapple drink (B)	
Frankfurters (T)	Corned beef (T) (I)	Ham (T) (I)	Ground beef w/pickle sauce (T)
Turkey tetrazzini (R)	Asparagus (R)	Cheese spread (T)	Noodles and chicken (R)
Bread (2) (I) (NF)	Bread (2) (I) (NF)	Bread (2) (I) (NF)	Stewed tomatoes (T)
Bananas (FD)	Pears (T)	Green beans and broccoli (R)	Pears (FD)
Almond crunch bar (NF)	Peanuts (NF)	Crushed pineapple (T)	Almonds (NF)
Apple drink (2) (B)	Lemonade (2) (B)	Shortbread cookies (NF)	Strawberry drink (B)
		Cashews (NF)	
		Tea w/lemon and sugar (2) (B)	
Shrimp cocktail (R)	Beef w/barbeque sauce (T)	Cream of mushroom soup (R)	Tuna (T)
Beef steak (T) (I)	Cauliflower w/cheese (R)	Smoked turkey (T) (I)	Macaroni and cheese (R)
Rice pilaf (R)	Green beans w/mushrooms (R)	Mixed Italian vegetables (R)	Peas w/butter sauce (R)
Broccoli au gratin (R)	Lemon pudding (T)	Vanilla pudding (T) (R)	Peach ambrosia (R)
Fruit cocktail (T)	Pecan cookies (NF)	Strawberries (R)	Chocolate pudding (T) (R)
Butterscotch pudding (T)	Cocoa (B)	Tropical punch (B)	Lemonade (B)
Grape drink (B)			

*Abbreviations in parentheses indicate type of food: T=thermostabilised, I=irradiated, IM=intermediate moisture, FD=freeze dried, R=rehydratable, NF=natural form, and B=beverage.

Mechanical subsystems.


BODY FLAP HYDROMECHANICAL ACTUATION
RUDDER/SPEED BRAKE HYDROMECHANICAL ACTUATION
VENT DOOR MECHANISMS (BOTH SIDES)
ELEVON AERO/THERMAL SEAL PANELS MECHANICAL ACTUATION
REMOTE MANIPULATOR SYSTEM (NOT ON STS-1)
CREW EMERGENCY EGRESS PYROTECHNIC ACTUATION MECHANISMS (2)
CREW TRANSFER TUNNEL KIT (NOT ON STS-1)
CREW INGRESS/ EGRESS HATCH MECHANISM (LEFT-HAND SIDE)
AFT EXTERNAL TANK SEPARATION
PAYLOAD RETENTION
STAR TRACKER DOORS (2)
ELEVON SERVO AND SURFACE ACTUATORS
MAIN LANDING GEAR
FORWARD EXTERNAL TANK SEPARATION
PAYLOAD BAY DOORS ACTUATION AND LATCHING
YAW AND BRAKE CONTROL PEDALS
NOSE LANDING GEAR
DEPLOYABLE RADIATORS ACTUATION AND LATCHING
DEPLOYABLE AIR DATA SENSOR (BOTH SIDES)

SSME propellant flow schematic.

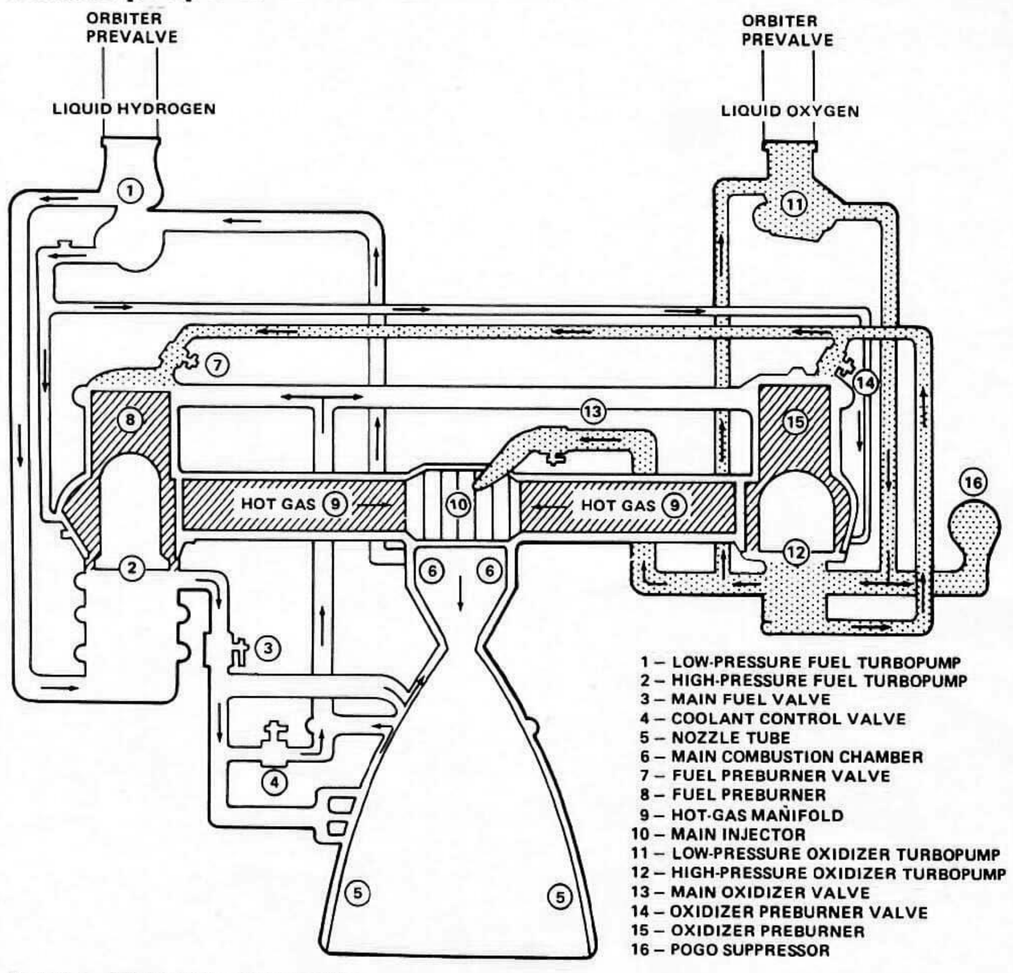

ORBITER PREVALVE
LIQUID HYDROGEN
ORBITER PREVALVE
LIQUID OXYGEN
HOT GAS (9)
HOT GAS (9)
1 – LOW-PRESSURE FUEL TURBOPUMP
2 – HIGH-PRESSURE FUEL TURBOPUMP
3 – MAIN FUEL VALVE
4 – COOLANT CONTROL VALVE
5 – NOZZLE TUBE
6 – MAIN COMBUSTION CHAMBER
7 – FUEL PREBURNER VALVE
8 – FUEL PREBURNER
9 – HOT-GAS MANIFOLD
10 – MAIN INJECTOR
11 – LOW-PRESSURE OXIDIZER TURBOPUMP
12 – HIGH-PRESSURE OXIDIZER TURBOPUMP
13 – MAIN OXIDIZER VALVE
14 – OXIDIZER PREBURNER VALVE
15 – OXIDIZER PREBURNER
16 – POGO SUPPRESSOR

Figure 2-3.—SSME propellant flow schematic.

CREW EQUIPMENT

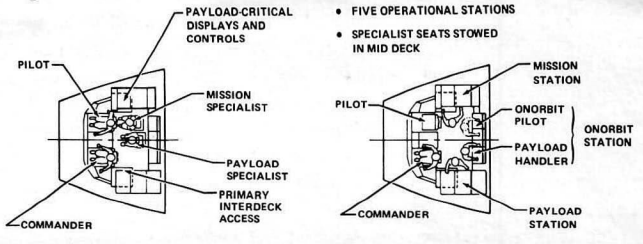
The normal complement of crew equipment will provide supplies for a standard crew of four for a mission of 7 days. The equipment is designed to be used in the Orbiter shirt-sleeve environment by 90 per cent of the male/female population. All the equipment, with the exception of the flashlight, is designed for use only inside the pressurized crew compartment of the Orbiter. The flashlight is also designed to operate while on extravehicular activity. The survival kit and lifevest are designed to remain completely functional following an abort landing.

Clothing – will be issued on a standard sizing schedule to fit the male/female crew. All clothes, with the exception of underwear, are common to both sexes. Cotton-blended tube socks are provided for all crewmembers. All clothing will be made of commercially available fabrics. With routine maintenance and repair, the useful life of the clothing is expected to be 30 operational missions based on a nominal mission duration of 7 days. All clothing will be recycled between missions for use by crewmembers of equivalent size. A 7-day mission clothing set for one crewmember will not exceed 10 kilograms.

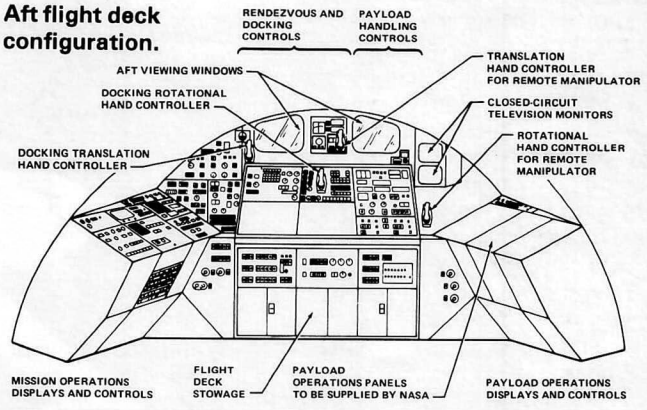
Personal hygiene kit – is designed to support a crewmember's personal hygiene requirements for a standard mission lasting 7 days. The kit contains a razor, shaving cream, a styptic pencil, skin emollient, sick deoderant, nail clippers, comb and brush, dental floss, toothbrush, toothpaste, antichap lip balm, and soap. Standard products are expected to be used in the kits, but each crewmember will be allowed to make a limited personal selection of alternative commercial preparations and optional kit components.

Miscellaneous provisions – The crew will also have both paper and cloth towels suitable for general-purpose dry utility wipes, or, when wet, suitable for washcloths for shaving, cleansing, and other similar tasks. Trash containers will be provided for temporary stowage of waste materials. The crew will be provided with a Swiss Army-type pocketknife, scissors, sunglasses, a chronograph, a sleeping mask, sleeping earplugs, general-purpose adhesive tape, a Velcro kit, in-flight restraining devices, a Mylar mirror with Velcro attach points, and a small portable desk.

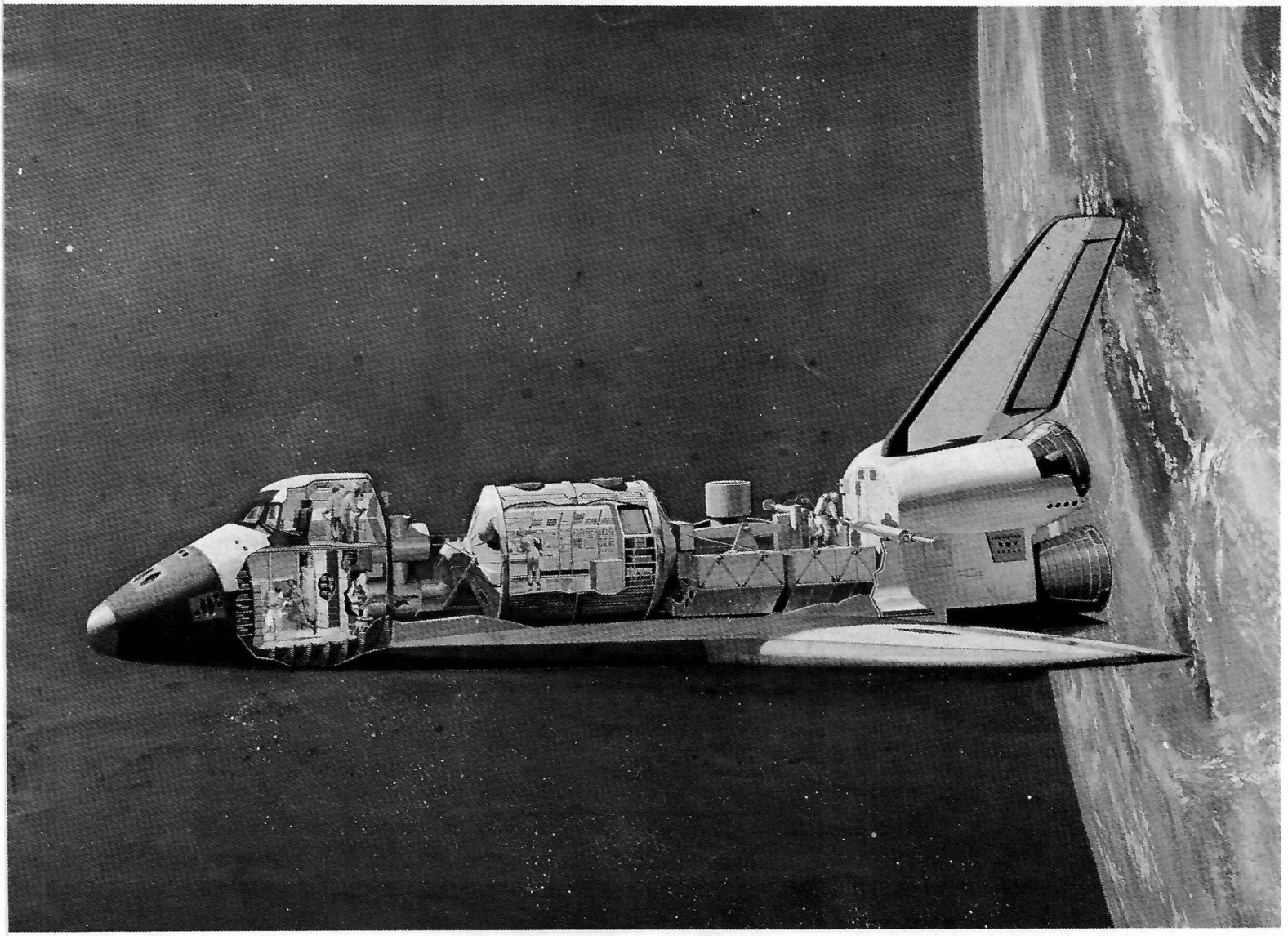
Flight-deck crew cabin arrangement

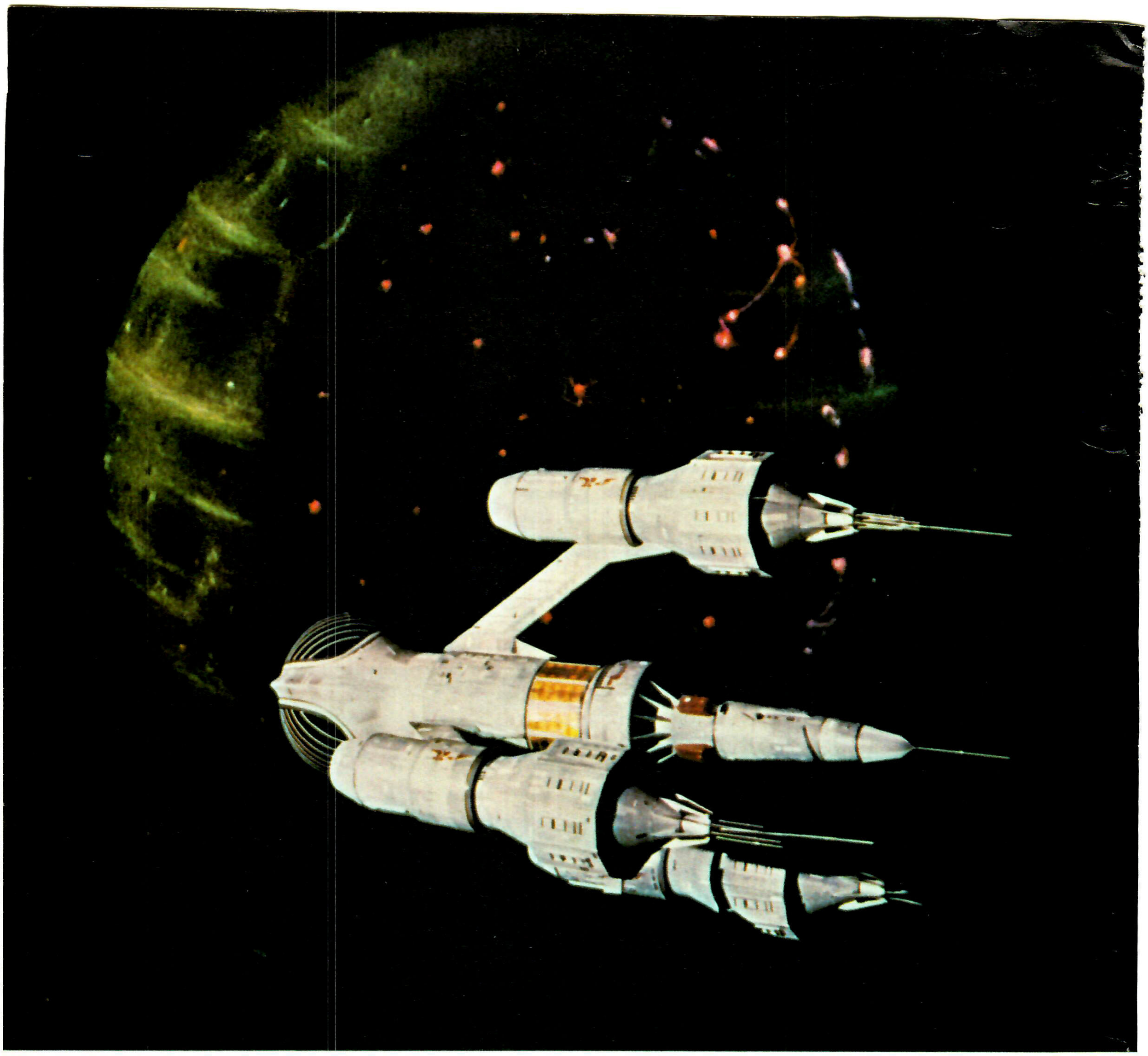


Aft flight deck configuration.


RENDEZVOUS AND DOCKING CONTROLS
PAYLOAD HANDLING CONTROLS
AFT VIEWING WINDOWS
TRANSLATION HAND CONTROLLER FOR REMOTE MANIPULATOR
DOCKING ROTATIONAL HAND CONTROLLER
CLOSED-CIRCUIT TELEVISION MONITORS
DOCKING TRANSLATION HAND CONTROLLER
ROTATIONAL HAND CONTROLLER FOR REMOTE MANIPULATOR
MISSION OPERATIONS DISPLAYS AND CONTROLS
FLIGHT DECK STOWAGE
PAYLOAD OPERATIONS PANELS TO BE SUPPLIED BY NASA
PAYLOAD OPERATIONS DISPLAYS AND CONTROLS

ALL ILLUSTRATIONS: NASA



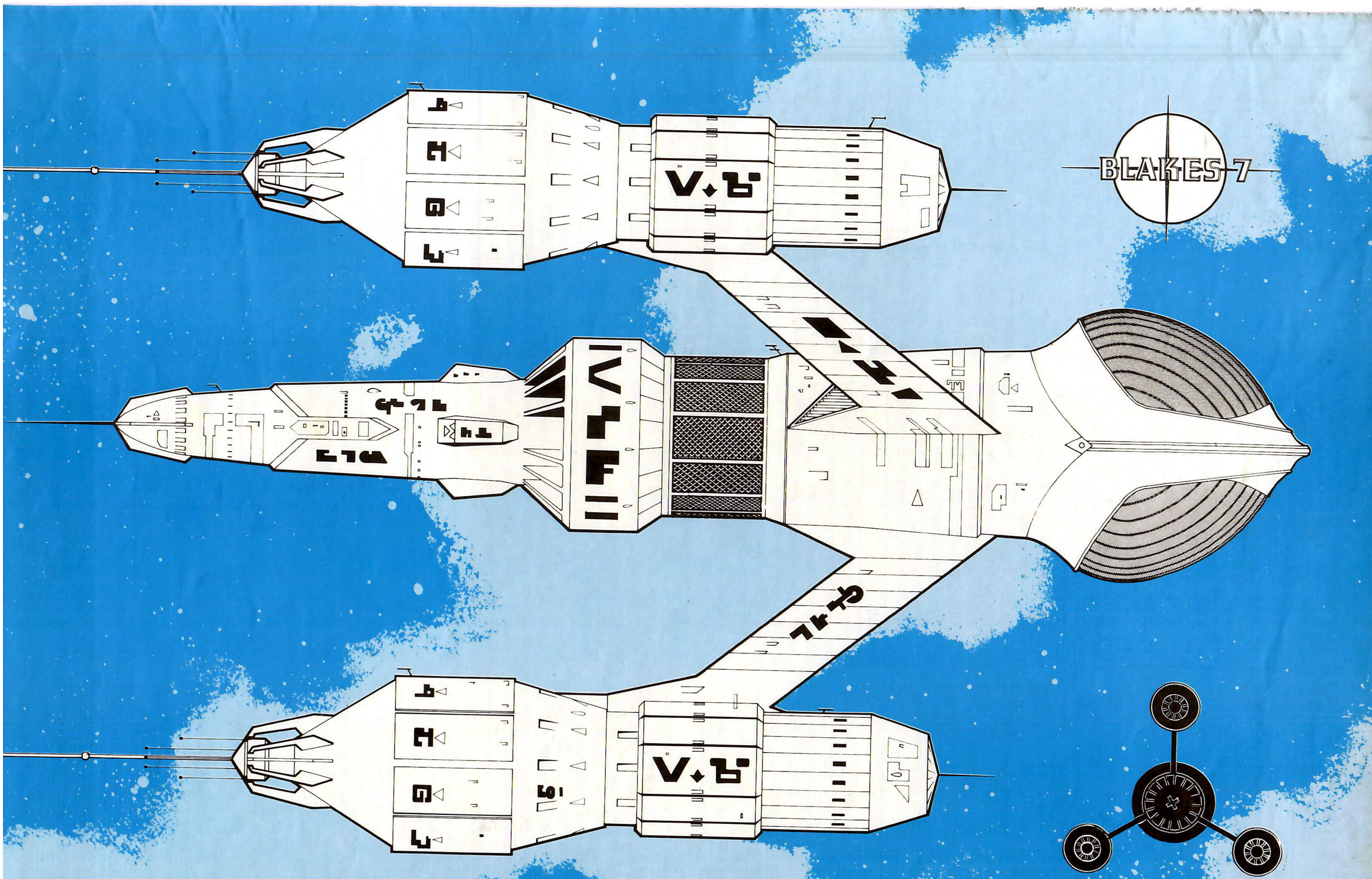


BLAKE'S 7

EXCLUSIVE DRAWINGS AND PICTURES FROM BBC TV'S HUGELY SUCCESSFUL SCIENCE FICTION DRAMA WHICH HAS JUST COMPLETED ITS FOURTH SERIES.

Blake's 7 starships past and present. Above, the **Liberator**, ***which appeared throughout the first three seasons, shown here over 'Star One'. Left, the current vessel,*** **Scorpio**, ***nestling in its underground silo.***

Photos: Mat



DEEP SPACE VESSEL NAMED 'LIBERATOR'

DRAWN BY IAN AMBROSE FROM THE ORIGINAL DESIGN BY ROGER MURREY-LEACH

The Federation

After the Atomic Wars there emerged from the ensuing chaos, a dictatorship so powerful that it enmeshed the majority of Earth-populated worlds. As the Federation grew in power, so the hard-won freedom of the people it ruled disappeared.

The President is the absolute ruler of the Federation. Surrounded by his personal guard and his political appointees he is the most powerful man in the galaxy. The centre of his empire is Earth.

Each planet in the Federation is under the jurisdiction of a governor appointed by the Presidential High Council and directly responsible to the President. Although some planets retain a semblance of liberty, trying to exercise this liberty is considered a crime and therefore punishable. Not all the governors are dictatorial – some do try to maintain a certain amount of autonomy – but usually without success.

The vast majority of the population of the Federation lives in a drug-induced world of docility. The suppressants are administered forcibly. Society is strictly structured from the elite Alpha grades to the menial Delta service grades. The higher the grade, the more privileges. Pleasure planets and satellite cities exist for those wealthy enough to be able to enjoy them.

There are rebels in the most heavily-suppressed society. Those who are not content with their drug-soaked lives turn either to crime or resistance. The big criminal organisations are allowed to continue their operations with the Federation officials taking their cut. Dissident movements are, of necessity, quite small but are of sufficient nuisance value that it is considered advisable to liquidate them.

Blake's *7?*

In the beginning there was Blake, Avon, Jenna, Vila, Cally, Gan the gentle giant, and Zen the almost human computer – seven in all.

Backed by the spaceship *Liberator* their audacious confrontations with the Federation brought fearful dangers and it was not long before Gan was killed giving his life to save his friends. Then in a catastrophe, Blake and Jenna disappeared. But the numbers were made up when the renegade Tarrant joined the crew and an amazing underwater venture brought in Dayna.

Ultimately the destruction of the *Liberator* stilled the voice of Zen, Cally is murdered and the crew were stranded on icy *Terminal* with Orac their only hope.

But who was the cool blonde that joined them now? And what's this new creepy-talking computer? Their names are *Soolin* and *Slave*. So now – and you can add it up for yourself – the followers in Blake's pioneering footsteps are: *Avon, Vila, Tarrant, Dayna, Soolin, Slave and Orac.* Blake's Seven!

Distances

As you know, one light year is 5880 thousand million miles. The nearest star to our own Solar System is Alpha Centauri which is 4·29 light years away (approximately 25 000 thousand million miles). Astronomically speaking that's just outside the back door. It is estimated that in our galaxy alone there are perhaps 150 thousand million stars. It is further estimated that in the part of the Universe which we can now observe with our best instruments there are at least 100 thousand million galaxies. The nearest large one is Andromeda which is probably 750 000 light years away and the most distant probably several billion. Current estimates suggest the Universe is 26 thousand million light years in diameter . .

Spacials

A small, not very specific, unit of distance. Never used for a long journey in space but only for limited distances thus: *Scorpio* usually goes into stationary orbit 1000 spacials above a planet's surface if our heroes wish to teleport down.

Because of *Scorpio*'s shuttle-and-lift-off capability it can land on most planetary surfaces as well.

Speeds

Travelling at four times the speed of light it would take about 15 months to reach Alpha Centauri . . .

'Standard By'

When they first entered *Liberator* our heroes had no idea what sort of speed she was capable of. They accordingly asked its computer *Zen* to fly the ship at Standard speed. They have been using multiples of this ever since.

Time Distort

The unit of speed used by most craft. Time Distort Six is average cruising speed.

Force Wall

As the name implies this is an energy barrier put up around battle craft to protect them from meteorites, plasma bolts etc. *Scorpio,* being originally a transport vehicle, does not have total capability in this area.

Plasma Bolts

Fired by Federation Pursuit Ships, these are huge balls of superheated glowing fusion reaction power. Unprotected objects are instantly vaporised.

The new ship Scorpio

Scorpio was originally designed as an inter-stellar cargo ship. Tarrant recognised it at once and described it as: *'A Wanderer class planet-hopper. Mark II by the look of it. Obsolete but functional.'*

Pressurised doors seal off the cargo areas from the flight deck when the ship is operational, and all-round surveillance is maintained by forward and rear observation screens. There is also a locker containing side arms.

Weaponry

The Clipguns are made of Argentium. They are recoil-less and can fire underwater. Designed to fire a variety of projectiles they have a guide-sight mounted on top and their emissives are laser-guided to target. The 'Clips' – or Magazines – are colour coded to indicate the projectile. Standard colour is black and with this 'Clip' inserted the gun fires small but deadly plasma-bolts. *'In fact,'* as Dayna says, *'you have a weapon for every occasion: laser, percussion shell, micro-grenade, stun, drug, they're all here!'*

Bracelets

The Scorpio Bracelets are made of Titanium and are also two-way transmitters with internal aerials. They incorporate sensors which warn of the presence of poison gas or radiation.

The Bracelets are worn all the time as the personal property of each member of the crew. 'Chips' are set in a rack with a 'Keyboard' so the co-ordinates of a landing site can be programmed into the chips and then inserted into the bracelet.

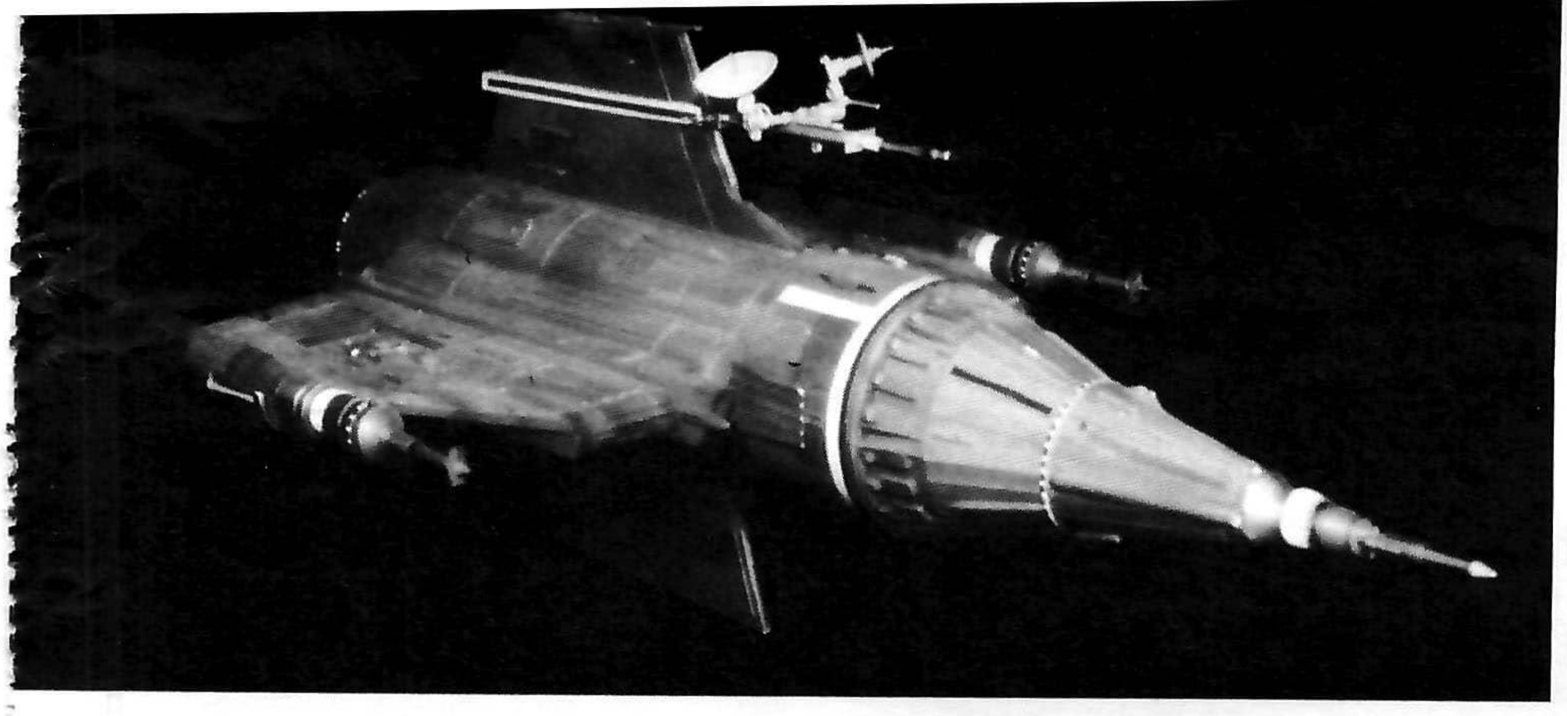
The Base

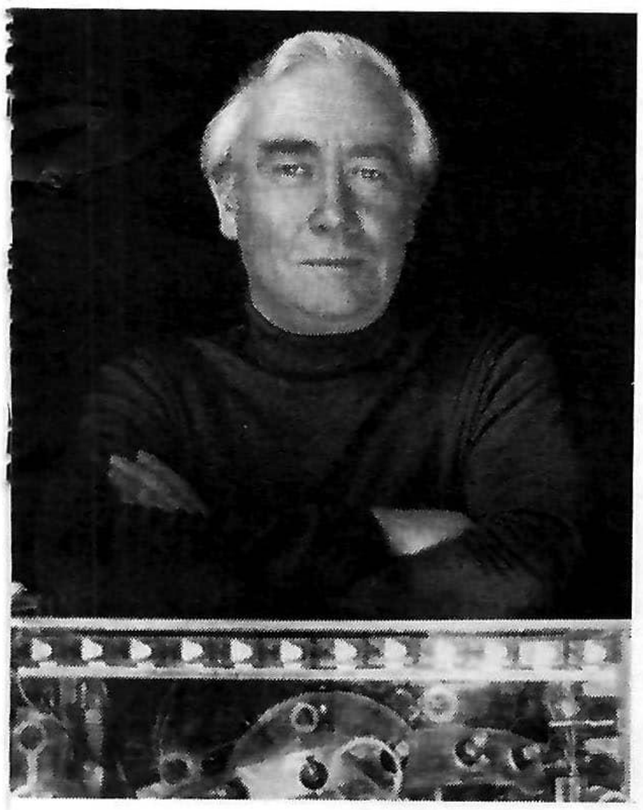
On Planet Xenon. A huge elevator in a silo brings *Scorpio* to surface for blast-off. Down below, reached by a maze of passages, are two main areas: The Ops. Room where *Scorpio*'s teleport technology is duplicated, and the Crew Room where all can eat, drink and relax.

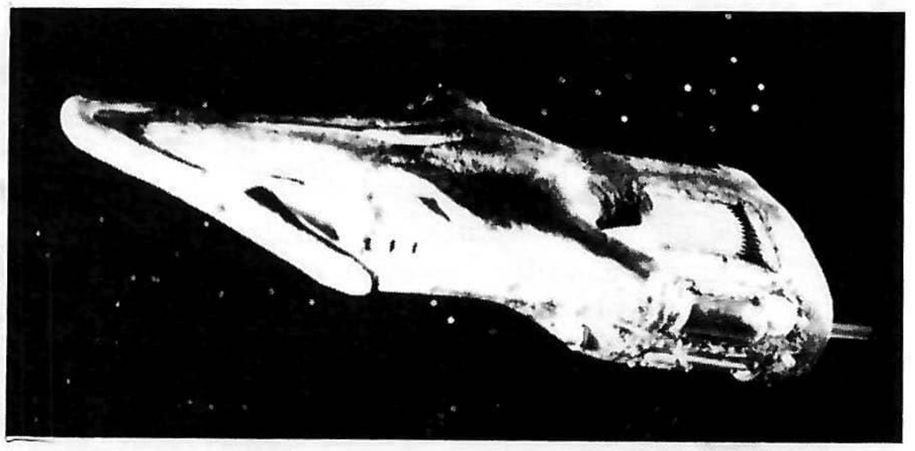
ACKNOWLEDGEMENTS

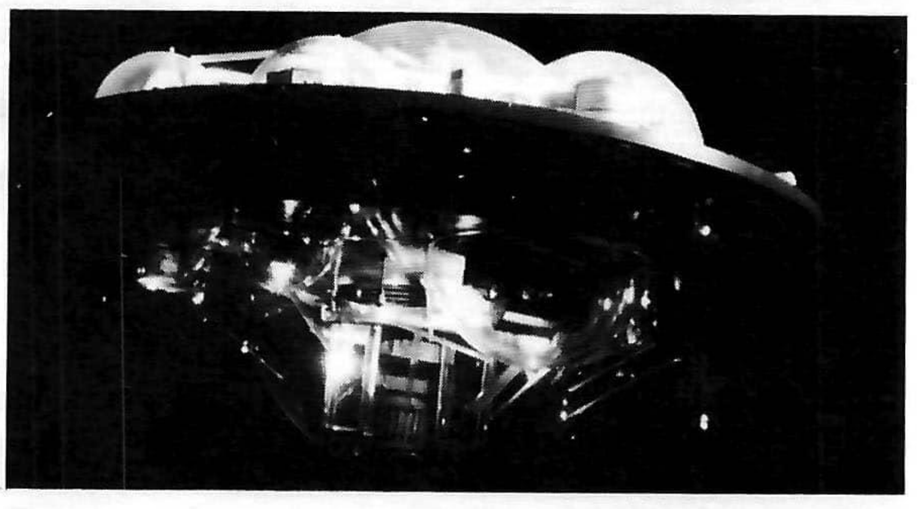
Thanks to the following individuals for permission and use of Blake's 7 material: Terry Nation, Tim Hampson of Marvel Comics Ltd., publishers of Blake's 7 magazine, and Martin Hussey of BBC Enterprises.

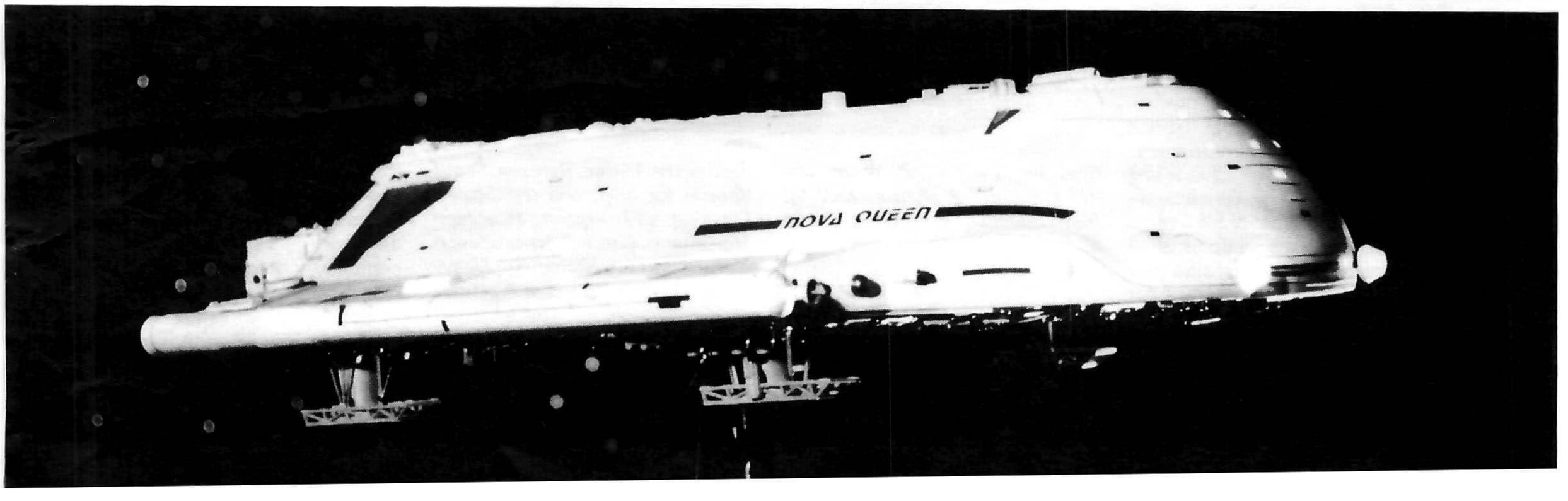
Top row: Left, a Federation Pursuit Ship and right, the Atlay Shuttle from the second series. Second row: Left, Peter Tuddenham, the voice behind Orac. Centre, the crew of Scorpio: Tarrant, Dayna, Avon, Vila and Soolin and, at far right, their arch enemey Servalan. At right, Martin Bower, one of many technicians who worked on the big Liberator model. At far right, more effects models from Blake; Servalan's Federation Ship from the third series and Space City from the 'Shadow' episode of the second series (below). At foot, the Nova Queen from the Star One episode.










NOVA QUEEN

PRODUCTS

Empire Strikers in plastic

MPC's latest *Star Wars* kits hark back to quite a few years ago when they were producing *Space 1999* items. Besides the *Eagle* and *Hawk,* both of which also appeared under the **Airfix** label, there were two other associated kits. One, the *Space 1999 Alien,* was nothing more than a renamed George Barris Moonscope vehicle (see also *Space Model Survey*), but the other was a diorama of the Alpha Moonbase.

Although having been available in the United States for a few months now, the new **MPC** *Star Wars* kits have yet to be unleashed onto the UK market, but we now understand that a tentative date of May is scheduled for release in this country under the Airfix label. There will be three kits altogether and all based on hardware (and software) from *The Empire Strikes Back,* which is dealt with elsewhere in this issue.

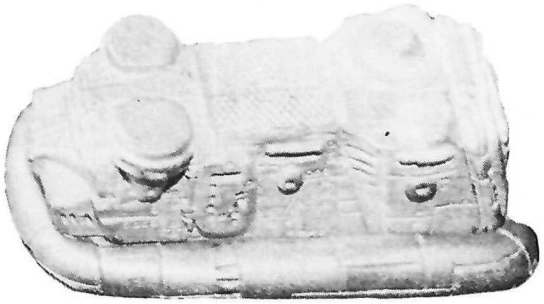
The Imperial Walker – AT-AT (*All Terrain-Armoured Transport*) stands some eight inches high, to render it approximately 1/72nd scale, and features a movable turret head (retained by an elastic band) with poseable legs. It is a far superior model than many other kits of a similar nature; well detailed, carefully moulded and the finished replica actually *does* match the film effects version. We hope to review this model in greater depth in a future issue of Space VOYAGER.

Also scheduled for May release are two snap-together kits of scenes from *The Empire Strikes Back* and each goes for the opposite end of the spectrum. The bigger kit packs an incredible number of items to re-create the 'Battle on Ice Planet Hoth'. Here you get three AT-ATs (one of which has been felled); one *Scout Walker* (that's the small two-legged version); three *Snowspeeders;* three Laser Turrets; two Photon Guns; one *X-Wing* Fighter; 34 Rebel Troops and 16 Imperial Stormtroopers; and all this on a base $11\frac{3}{4}$ in. x $17\frac{3}{4}$ in.! Colleague Andy Yanchus reports that Tom West of MPC (who kindly supplied the samples of all the latest *Star Wars* kits) says they were aiming for 1/150th scale. I reckon they just about got it, calculating from the figures and the AT-ATs in particular. If the scale of the larger

AT-AT kit is correct (Andy has calculated 1/72nd and I've independently calculated 1/75th), the diorama versions are virtually half this size. Of course you don't have to restrict yourselves to the supplied vacformed base – some very effective scenes could be made on a larger layout.

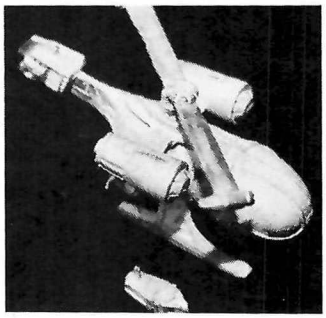
Dagobah provides an amusing little vignette with *Yoda* and Luke Skywalker inside the Jedi master's house with *R2D2* looking through the window. The roof of the house lifts off to reveal the interior which could possibly offer even greater potential. Some imagination, coupled with careful use of fibre optics, could create some really interesting effects. Luke, *Yoda* and *R2-D2* and their scale seems to work out to around 1/10th. but *Yoda's* house – with its modern open-plan living – isn't to the same scale. Andy Yanchus reckons the **Kenner/Palitoy** figures would fit better . . .

Airfix/MPC kits are distributed in the UK by **Palitoy Ltd.** of Coalville, Leics. and other kits include the *TIE Fighter, X-Wing, R2D2, C3PO,* and the 1/72nd *Millennium Falcon.*



Imperial Vehicles

From **Tabletop Games,** of 53 Mansfield Road, Daybrook, Nottingham, a few samples from a huge range of 15 mm scale SF metal figures and vehicles. That shown above is a *Glaive Class Squad APCS* (below) which is available with four different bases: *Antigrav, Wheeled, Tracked* and



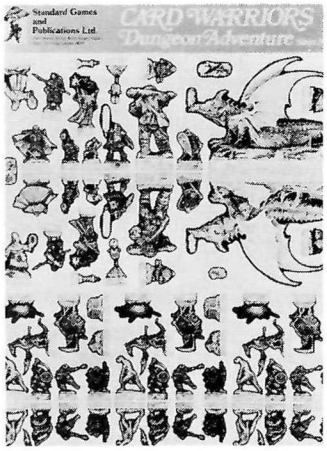
Hover. Quality of casting is good throughout and a quick spray of white cellulose primer will be sufficient to seal the surface before painting. The Glaive Class vehicles retail for £1.10 each plus 10% for postage and packing from the above address.

Other SF models from TTG include the 15mm *'Partizan' Scout Vehicle* for 50p, and the *Scythe Class Squad Transport Jetcopters.* The latter is in three versions, each with different weapons; *Heavy Laser, Conversion Beam Projector* or *Missile Launcher.* The Jetcopter models retails for £1.80 each and the big *Scorpion 12 man-assault vehicle* retails for £2.10.

Standards and Warriors

From **Standard Games and Publications Ltd.,** come 25 mm card warriors of *Dungeon Adventurers* and *Savages and Swordsmen.* Retailing for a modest £1.55 per sheet, these super figures are printed in full colour on stout card, 284 mm x 239 mm, from which they must be individually cut. There are two sides for each figure to be cut out and glued together, leaving only the exposed white edges to be touched in with black paint or felt-tip pen. An additional card is supplied printed with a terrain pattern. We were highly impressed by both the quality of the artwork and the printing.

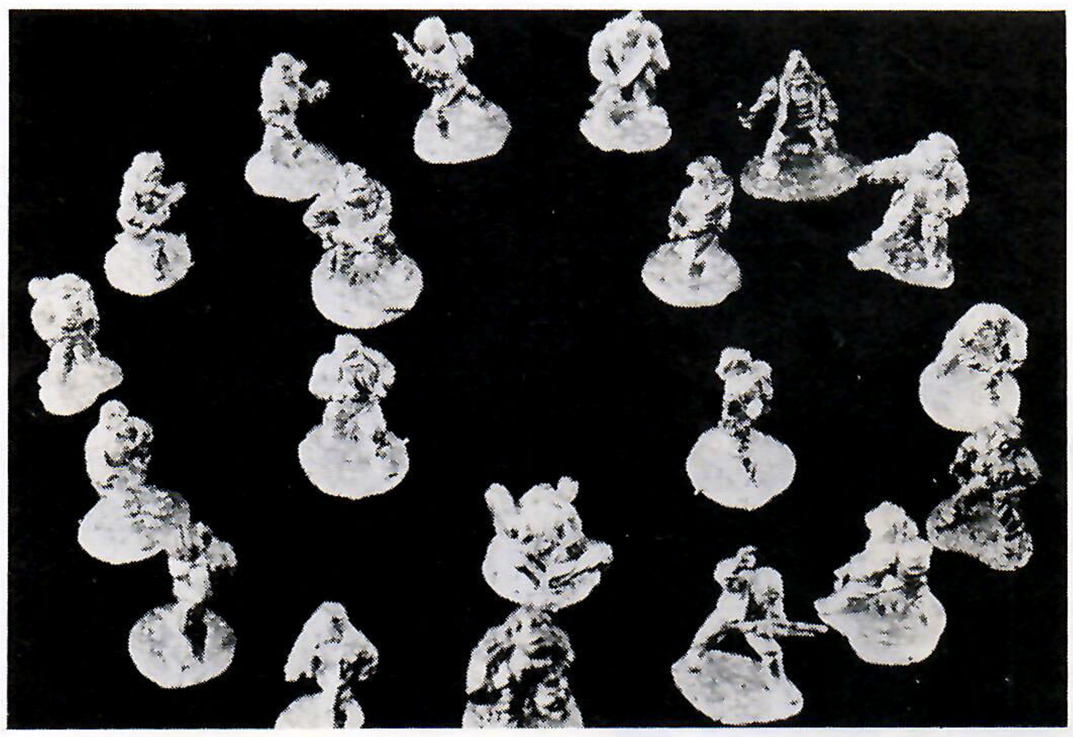
Also recently released by Standard Games are large coloured



hex sheets (each hex measures 1 inch) – silk-screen printed on baize with the other side plain – ideal for those larger games. Colours available so far are black, blue, green and sand and they retail for £7.95 for the 6 ft x 4 ft size, plus 50p for postage and packing.

Citadel Miniatures

When it comes to selecting a handful of fantasy figures to augment a role-playing game, one is hardly spoilt for choice. Amongst the World leaders in the business is **Citadel Miniatures** of Newark, Nottinghamshire, and it is an assortment of figures from this company that we are concerned with here. First, *Adventurers,* one of the boxed set range specially produced for use with **Traveller** boxed role-playing games; if this is all new to you, turn to Steve



Above, contents of 'Adventurers' – a boxed set of figures by Citadel Miniatures and specifically produced for Traveller role-playing games. Below right, RuneQuest figures – new for 1982. Those shown are Adventurer, Demi-Bird and Broo.

Jackson's feature, starting on page 12, for enlightenment. There are five boxes in the Traveller range – Box 1: *Adventurers;* Box 2: *The Military;* Box 3: *Ship's Crew;* Box 4: *Citizens* and Box 5: *Aliens;* each box retails for a reasonable £3.95.

Coming under our reviewer's scrutiny is Box 1 containing, as do the others, 20 individual figures (no duplicates) to 15mm scale. Considering the average height of each figure is less than $\frac{3}{4}$ in. detail is crisp, animation first class and there's hardly a trace of flash. They really are superb little castings and, once primed with matt white cellulose spray, will offer a challenge for painting in the colours of your choice. The box contains a special foam liner to hold the figures when not in use and each subject is illustrated on the reverse with identifying captions.

Another popular boxed role-playing game is **RuneQuest** and new from Citadel is a range of figures designed specifically for this system. The subjects include the *Adventuress, Adventurer, Trollkin, Broo, Jack O'Bear, Manticore, Baboon* and *Demi-Bird,* the latter very similar to the prehistoric *Phorahacos.* These figures are slightly larger, average height is around $1\frac{1}{4}$ in. and again one cannot fault the fidelity of the castings. There's barely any flash and the detail wrought from these miniatures is quite astounding. Our favourite is the Manticore; somewhat of a cross between a man, lion, dragon and scorpion – some pedigree! Collectively boxed, this RuneQuest selection will be available later this year.

Finally, we turn to the **Fantasy Tribes** range also produced by Citadel. This popular series includes Gnolls, Dwarves, Trolls, Orcs and Skeletons at various prices. All are individually packaged in a polythene bag with a fold-over card header. There was a little flash present on some of these but a moment's work with knife or file soon put matters to rights. Like the other Citadel products reviewed here, the castings are very good indeed and reflect the skill of the master pattern maker.

These figures are just a fraction of what is available and we refer you to advertisements (*White Dwarf* magazine for example) for some indication of the number of similar lines manufactured. We are grateful to **Games Workshop** of Sunbeam Road, London, for supplying the review samples.

CONVENTIONS

Feb 6	COMICMART, Central Hall, Westminster (opp. Parliament), London. Market for comics, books, stills etc. Free entry – no need to book. Noon-4 pm approx.
Feb 13-14	SCOUSE CON, Liverpool. Media Con. Roy Evans, 77 Selby Road, Orrell Park, LIVERPOOL, L9 8EB.
Mar 20	MEDIACON, London. Mixed Con. Kim Campbell, 8 Flaxman Road, London, SE2.
Apr 2-4	SHORE LEAVE, Glasgow. *Star Trek* Con. Lesley McCartney, 74 Castlefern Road, Fernhill, Rutherglen, GLASGOW, G73 4AU.
Apr 3	COMICMART – as February.
Apr 9-12	CHANNELCON, Brighton. Easter SF Con. Channelcon, 4 Fletcher Road, Chiswick, London, W4 5AY.
Apr 30-May 2	UFP Con, Birmingham. *Star Trek* Con. GOH William Shatner, Kim Knight, 135 Greenstead Road, LOUGHTON, Essex, LG10 3DJ.
May 28-31	LEXICON, Leicester SF Con. Tony Cullen, 43 Station Road, Kirby Muxloe, LEICESTER, LE9 9EL.
June 5	COMICMART – as February.
June 26	COLNECON, Colchester. SF & Media. Alex Stewart, 11a Beverley Road, COLCHESTER, Essex, CO3 3NG.
July 2-4	FANTASYCON VIII, Birmingham. Fantasy GOH Tanith Lee. Penny Hill, 53 Glencoe Street, Anlaby Road, HULL, N. Humberside, HU3 6HR.
July 23-26	FAIRCON, Glasgow. SF & Media GOH Harry Harrison. Faircon 82. C/o 1/r 39 Partickhill Road, GLASGOW, G11 5BY.
Aug 7	COMICMART – as February.
Aug 7-8	EDGECON, London. Blake's Seven con. At The Edge of The World. c/o 26 Stanlake Road, Shepherd's Bush, London, W12 7HP.
Aug 27-29	GALILEO CON, Newcastle. *Star Trek* Con. Tina W Pole, 11f Prior's Terrace, Tynemouth, North Shields, TYNE & WEAR, NE30 4NE.
Oct 8-10	FANDERSON CON. London Gerry Anderson Con GOH Gerry Anderson. Pamela Barnes, 88a Thornton Avenue, Chiswick, London, W4 1QQ.
Oct 16	COMICMART – as February.
Nov 26	LEONARD NIMOY CON. Re. the actor who plays Spock in *Star Trek.* Nottingham. Carol Davies, 77 The Ridings, Ealing, London, W5 3DP.
Dec 3-5	TEAL VANDOR CON, London. Blake's Seven Con. Jill McCall, 34 Greenwood Close, MORDEN, Surrey.
Dec 11	COMICMART – as February.

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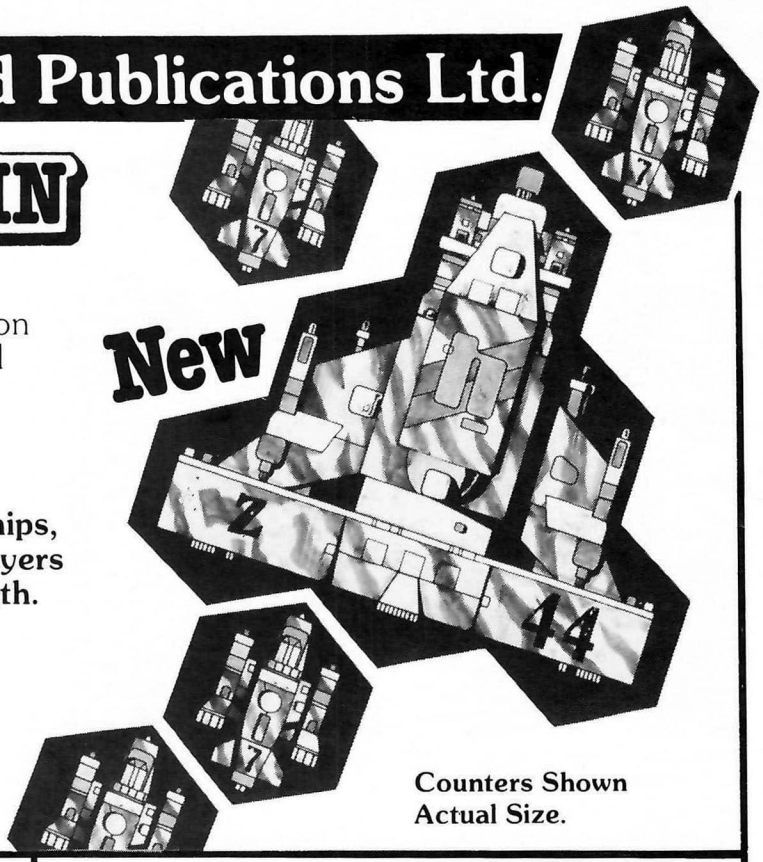

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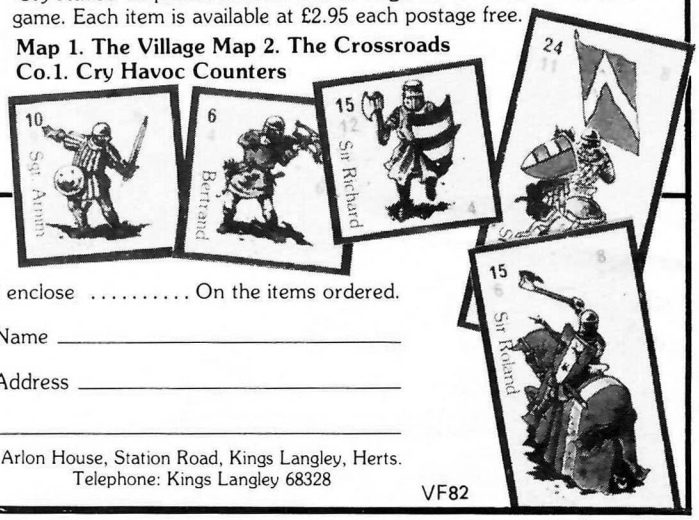

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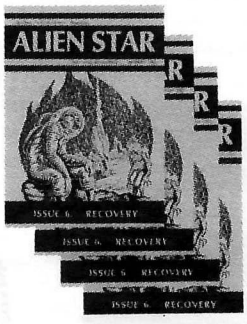

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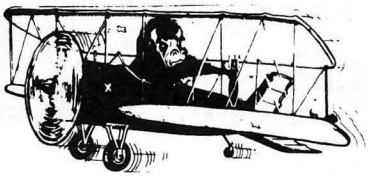

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LANDSPEE

The *Star Wars* saga has produced more than the normal complement of fictional hardware. Enterprisingly, the relatively small American model company of **MPC** has taken upon itself to provide a good percentage of the vehicles for the discerning modeller. *X-Wings* and *TIEs,* the *Millennium Falcon, Snowspeeder, Star Destroyer* and *AT-AT,* plus the two robots and two 'Action Scenes' have all graced the shelves of model shops. But there are a few missing, one of which is my personal favourite, Luke's *Landspeeder* from Episode IV, the first film.

It's unlikely to be kitted now as Luke sold the vehicle half-way through the film, but although there's no actual kit, **Kenner** do make a toy *Landspeeder* which is a good basis for conversion. Kenner, which along with MPC are part of **General Mills,** also own **Palitoy** in Britain, under which label the toy and diecast side is released. (GM now in fact also own **Airfix,** which itself has a fair selection of space-related items.)

Some of the toy *Star War* items are not suitable for conversion. There is, for example, a *Millennium Falcon,* but the overall dimensions are so far from the original that a conversion would turn into a complete scratchbuilding job. Of course this isn't necessary as MPC already make an excellent kit of the *Falcon,* but luckily the *Landspeeder* toy doesn't suffer from such exaggerations and is very close to the original. Gimmicks are restricted to 'floating suspension', controlled by a lever in the cockpit which can be stripped out by removing the four self-tappers holding the body together and prising the halves apart. The resulting holes can be filled with plastic card and **Green Stuff** or **Milliput** fillers. As accurate as it is, one major problem with the body shape concerns the port and starboard engine pods. It's almost as if whoever made the toy *Landspeeder* mould somehow got it back to front; although they are almost the correct shape, they are the wrong way round! The easiest solution is simply to reverse them. Carefully saw off the pods themselves, then remove the mounts from the body. Quite a bit of filler and plastic card will be needed, but this is the most straightforward method. This modification also helps to correct the rear end which, according to film stills, is much squarer in shape. The gaps that result in the pods being reversed at the back can be filled with pieces of shaped plastic card, with holes drilled at the bottom of each. The three engine pods themselves, to be absolutely accurate, should be oval in cross-section, but this is barely noticeable. However, the rear of each can be drilled out and a piece of ¼ in. **EMA/ Plastruct** tube, ⅛ in. long, fitted inside the opening. The front openings can have a small circle of metal mesh, such as that produced by **Plastic Padding,** fitted inside

Returning to the distinctive body shape, it's possibly slightly too thick, but correction would involve a complete sectioning job. The lines are greatly improved by removing the stick-on chrome stripes and thinning the recess down with 3/16th in. strips of plastic top and bottom. These need blending into the body and the louvres added from 3/32nd in. plastic strips. The bonnet (or should it be hood?) indentation is wrong; the rear line needs filling and the sides need extending up to the windscreen. This is carefully cut down from the toy version with a razor saw.

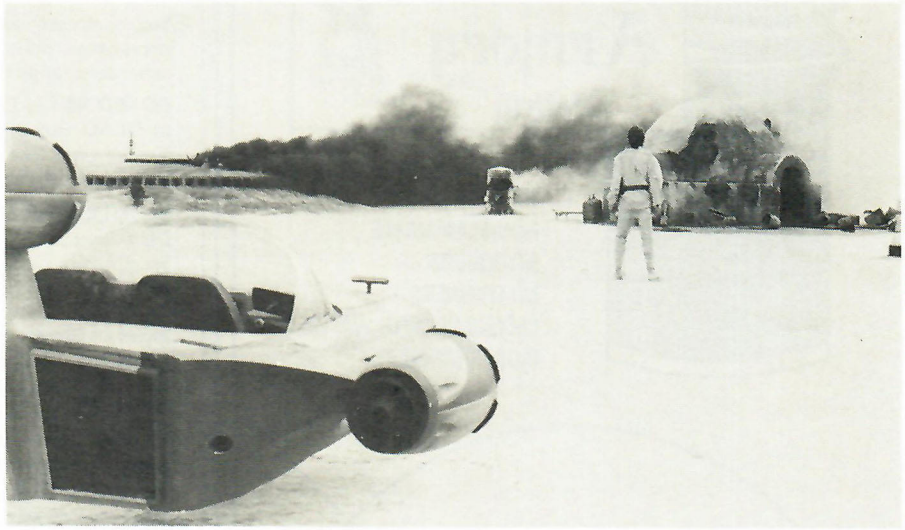
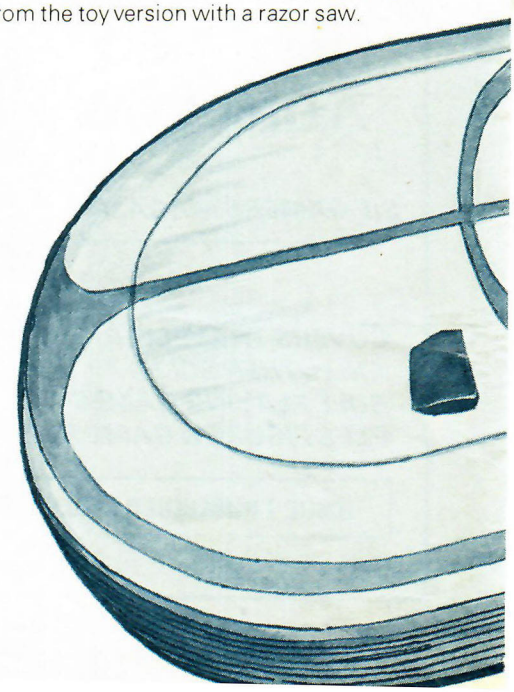


PHOTO: © 20TH CENTURY FOX

The completed Landspeeder (left) compared with the standard model as produced by Kenner Toys. All photos: Mat.

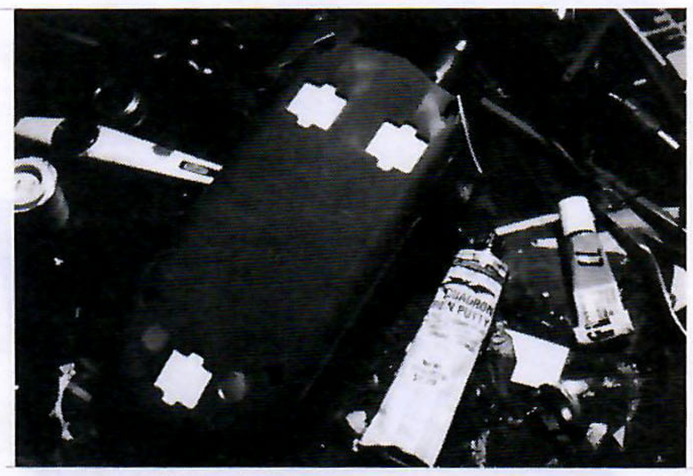


EDER

MAT IRVINE CONVERTS THE KENNER TOY

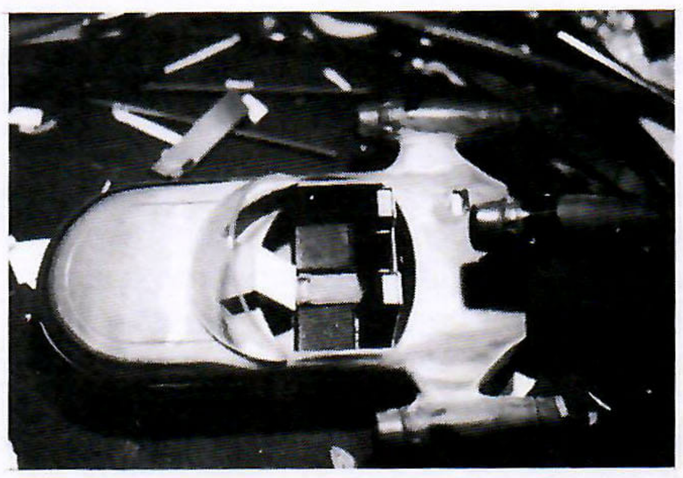
The interior is the other major modification. The seats and central console need removal, though the former are re-used with the backs cut off and re-glued at the base of the seats. The toy console can be modified by reversing and lowering, and the 'suspension' lever hole filled. The central 'instrument' panel will have to be constructed from plastic card, as will the two pods mounted on the original 'shelves' in front of the seats. The steering wheel follows aircraft practice in style and note that the vehicle appears to be right-hand drive, apparently being based on a Reliant chassis, and not left-handed as it appears below and in some American publications. The column and wheel are made up for ⅛ in. tubing. What must be the real gear shift is found on the central console with another panel just behind. The central instruments can be built up from plastic card sheet and strip, as can the two instrument pods.

Small details on the body itself include a recess just behind the driver, cut into the body and backed with plastic, some technical detail on the hood in front of the passenger – I used part of an old **Revell** Gemini kit – and finally what could be a radar device on the front of the hood. A short piece of tube, topped with a shaped plastic card wedge on top, forms this item. That completes the overall shape, the only other details are the bashes and bumps the original seemed to have received – intentionally or otherwise isn't clear. A coat of red car primer matched the original and the red stripes can be handpainted with **Humbrol** *Matt Scarlet.* The seats, instrument pods and panels are black along with the hood, mechanical detail and the interior of the engine pods. The louvres were painted with Humbrol *Gunmetal,* and the whole lot was given a liberal 'dirtying'.



Above, underside view of the model shows the floating suspension and self-tapping screw holes blanked off with plastic card. Note that both port and starboard engine pods have been removed.
Right, basic body completed; note reversed port and starboard engine pods, hood engraving line filled in, cut down windscreen, and cut-out behind driver's seat.

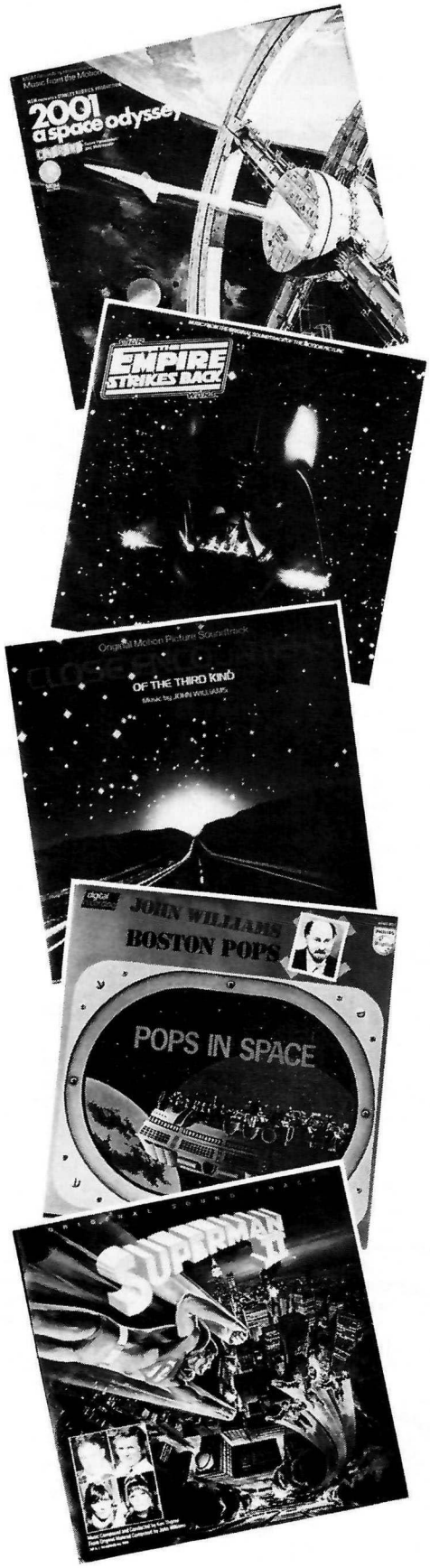
Above, more detail of the port and starboard engine pods; supports and pods have been removed with a razor saw.



SOUNDS

In the 1950s the musical accompaniment to a science fiction or fantasy film, however good that score may have been, did not, I would guess, rank all that high as a memorable part of the film. Things changed though in 1967 with the coming of the SF film of all SF films. Actually it is true to say it wasn't just the musical style that changed; virtually all styles that had preceded *2001 – A Space Odyssey* went through drastic modifications – storylines, cinematography, special effects, the lot. It took someone like Stanley Kubrick to completely abandon the specially-commissioned soundtrack score and instead go the reverse route and dive down the established recording catalogue. The catalogue he explored was *Deutsche Grammophons* and he unearthed the, then, obscure symphonic poem by Richard Strauss – Also Sprake Zarathustra – lifted the opening few bars and made one of the, if not *the,* most outstanding film themes of all time. Similarly, taking the, again relatively unknown, work of the Hungarian composer Gyorgy Ligeti and using it to accompany the desolate surface of the Moon and the incredible Star Gate sequence; what was even more daring was taking the very well known, hackneyed even, waltz of Johann Strauss and flying spaceships to it! We all know it works now, but at the time it must have seemed a bizarre risk. The record is still in the catalogues, MGM CS 8078, and should form an important ingredient in any film soundtrack collection.

From *2001,* although there was a slight lull in the new style of SF films in the early 1970s, by the time *Star Wars* came along, the new approach to musical soundtracks had not died a death, but had been modified. Now the idea was to use a specially-commissioned score, but have an established orchestra play it for you. Top of the tree came The London Symphony Orchestra, and top modern composer has to be John Williams. Williams had scored many other films, notably *Jaws,* and came to the LSO through Andrè Previn who was, at that time, principal conductor with the orchestra. Although John Williams was based in the US, as the *Star Wars* film was being made in Britain, the use of a British orchestra was fairly sensible especially since London has more orchestras to its name than any other major city in the World. The combination was a complete success and the double album got well into the LP charts. This was later repeated with *The Empire Strikes Back* although, for some odd reason, it was deemed that the States should receive a double album as before, whilst the UK would have to do with a single record. Luckily, the US version was available on import. Both sets of soundtracks are excellent value providing full details of tracks and players and, with the double *Empire* album, a full colour booklet as well. The number for *Star Wars* is 20C. Fox 2T.541 and for *The Empire Strikes Back;* UK version, RSO Super RSS 23 and the double American version, RSO RS-2-4201.



A selection of film classics on disc: 2001 – A Space Odyssey, The Empire Strikes Back, Close Encounters of the Third Kind, John Williams' 'Pops in Space' and Superman II, last year's hit movie.

John Williams also provided the score to Steven Spielberg's *Close Encounters of the Third Kind.* This time though, he went back to the States and used an un-named session orchestra for what I find a very symphonic piece of music. Ironically, I first heard excerpts from the score played by the LSO as part of their 'LSO in Space' concert, conducted by Williams. The record is on the Arista label and has the appropriate number, DLART 2001. It also contains a single-sided 45 record of the main theme done as a disco version, presumably in case Meco had the same idea. (Actually he did do it on his 'Meco – across the Galaxy' LP, RCA FL 43242.)

The re-issue of CE3K in its re-edited form as 'The Special Edition', meant John Williams had to provide some extra music. Presumably the record company did not think it worthwhile to re-master the original recording, but the new music is available from a different direction. John Williams recently took over as principal conductor of the Boston Pops Orchestra, succeeding the late Arthur Fiedler. On a record for Philips this new combination has recorded suites from *Star Wars, The Empire Strikes Back, Superman* and the *Special Edition of Close Encounters.* The record number here is Philips 9500.921.

It will be interesting to see whether the Boston Pops Orchestra will take over from the LSO for the third *Star Wars* film, and for that matter the *Superman* films. Somehow, John Williams had managed to fit in writing the score for the first *Superman* film, again using the London Symphony Orchestra but comes the second film, and this proves too much even for him. (I guess he was probably working on *The Empire Strikes Back.*) But all is not

lost, for Ken Thorne, noted film scorer himself, modestly took over and wrote the score, using the Williams' themes. One difference here was that the original film *Superman – The Movie* was a double album whilst *Superman 2* is but a single record. Record numbers are, for *1*-Warner Brothers K66084, and *2*-K56892.

Although John Williams has managed to score practically all the major SF films over the last few years, what he didn't accomplish was provided by another veteran of the industry, Jerry Goldsmith. He had previously scored for such films as *Planet of the Apes* and *Logan's Run,* as well as the TV series *The Man From UNCLE,* and indeed many other pieces, but his first recent foray was with the soundtrack of *Alien.* A difficult piece, discordant in places in keeping with the film's visual qualities, but extremely effective and containing as its theme one of the most hauntingly desolate pieces of music I've ever heard, played on muted trumpet and guaranteed to make your spine tingle. A disco version of this sounds highly improbable, but a very successful version was done by *Nostromo* on Bronze records, BRO 80. The soundtrack itself is on 20C Fox T593.

Jerry Goldsmith didn't use the LSO for his *Alien* soundtrack, instead this was played by the National Philharmonic Orchestra, conducted by Lionel Newman. For another of Goldsmith's scorings, that for *Outland,* the composer conducted the orchestra himself; not the best of SF films by any means and the music holds together considerably better than the story-line. A similar statement could possibly be said of Jerry Goldsmith's remaining recent SF film score, *Star Trek – The Motion Picture.* It was one of those films that *had* to be made, whatever the outcome, and although visually stunning, the plot left something to be desired. The music came over extremely well though, as with CE3K, played by an un-named group of musicians. The recording for *Trek* is on CBS 70174, and for *Outland,* Warner Brothers HS 3 551 and the latter is an import only.

Also available only as an import into the UK, surprisingly, is the soundtrack to the film that has done for inner space what *2001* did for the outer variety – *Altered States.* Written by a newcomer to film scores, though a respected composer in his own right, John Corigliano, the music has to deal with a certain amount of shock visual impact, and it reflects this. But the composer also cleverly manages to get the love theme interwoven in all the confusion, including a beautiful version played as a trio. The record is on the RCA label, number ABL 1–3983.

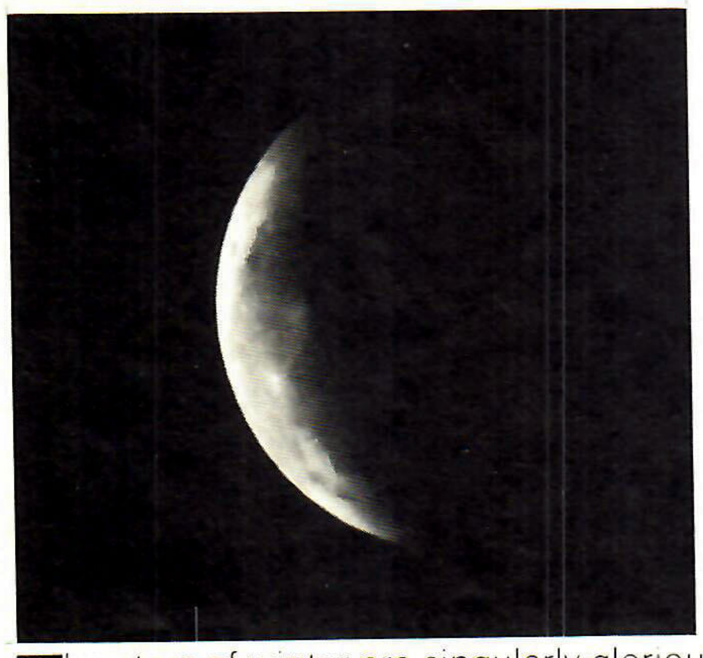
Finally in this round-up of favourite SF soundtracks, come two which were not block-busters at the box-office; in fact possibly they may have slipped from the memory, but both acquired that odd cult status. One, *Dark Star,* even became the cult film of cult films. Starting as a college project by John Carpenter (*The Fog, Halloween, Escape from New York*) and Dan O'Bannon (*Alien*), it was lengthened and transferred to the film circuits. The soundtrack has been rescued by Citidal Records, number CT 7022, and features most of the dialogue and sound effects, for the music itself would hardly fill one side. Definitely a must for the collector.

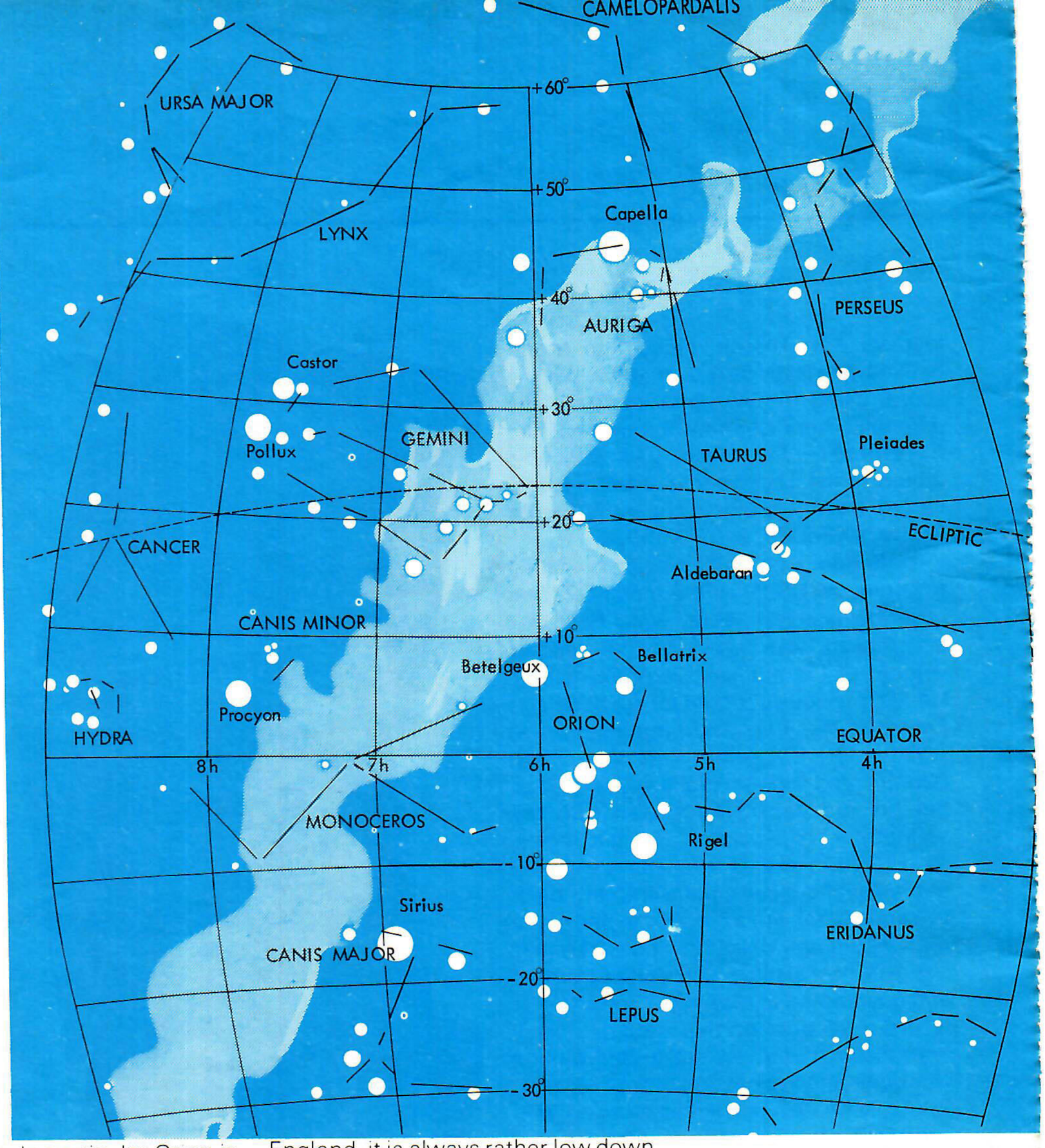
The other film is, in many ways, the opposite of *Dark Star.* Made for the wide screen, I remember originally seeing it in Cinerama where the full impact of the Space Fleet filling the screen was most apparent with the giant *Valley Forge* stretching half way round you. The film was *Silent Running* and directed by Doug Trumbell shortly after he worked on *2001* as one of the Effects Supervisors. (Later he returned to the effects side of things on *CE3K* and *Star Trek – The Motion Picture.)* The composition was by Peter Schickele who used a relatively, small and un-named orchestra to produce some very effective tracks. Two songs were featured with lyrics by Diane Lampert, and sung by Joan Baez; unusual for an SF film, but I feel they fitted the mood of the piece perfectly. The record was originally on MCA–MUPS 458, although it has been absent from their catalogue for some years. However I'm glad to say that it's been rescued by one of the smaller labels, Varèse Sarabande STV 81072, and although, again, only available in the UK as an import, should be found in some of the specialised shops. *Silent Running* does, I'm glad to say, appear on 'the box' from time to time, but it somehow lacks the granduer. The space fleet just isn't the same reduced down to a TV image as it was in Cinerama.

Jerry Goldsmith scored for Star Trek – The Motion Picture; next, Altered States, Dark Star and Silent Running; the latter both 'cult' films and often TV screened. Finally, one of the most recent SF film discs, for Outland. Photos: Mat

NIGHT SKY IN WINTER

PATRICK MOORE O.B.E.





The stars of winter are singularly glorious. In particular Orion is well seen – and there can be little doubt that Orion is one of the most magnificent of all the constellations. It cannot be mistaken; of its two leaders the brilliant white of Rigel contrasts strongly with the orange hue of Betelgeux, and there is also the superb Nebula, visible to the naked eye as a hazy patch below the three stars of the Hunter's Belt. Use a small telescope, or a pair of binoculars, and you will see the Nebula well. It is of special interest to astronomers; it is a stellar birthplace, and one of those regions in which new stars are being formed.

Rigel, of course, is a cosmic searchlight, perhaps 60 000 times as luminous as the Sun, while Betelgeux is large enough to hold the entire path of the Earth round the Sun. Like many red supergiants, Betelgeux is variable in light, but it is almost always brighter than Aldebaran in Taurus (the Bull), which is also of a strongly orange colour.

Follow the line of the Belt upward, through Aldebaran, and curve it slightly; you will come to the star-cluster of the Pleiades, or Seven Sisters, which has been known since very ancient times. It is interesting to see how many stars you can count without optical aid. Most people can see at least seven; the record is said to be as many as 19, and the whole cluster includes several hundred members. Look also for the Hyades, which extend in a sort of V-shape from Aldebaran. Actually, Aldebaran is not a true member of the group; it happens to lie almost midway between the Hyades and ourselves.

Downward, the Belt points to Sirius in Canis Major (the Great Dog), the brightest star in the sky. It is one of our nearest stellar neighbours, only 8·6 light-years away; it is 26 times as powerful as the Sun, and pure white. It often appears to flash various colours, but this twinkling or scintillation is due entirely to the Earth's unsteady atmosphere. Sirius twinkles particularly strongly, partly because it is so bright and partly because, as seen from England, it is always rather low down.

Note also Procyon, in Canis Minor (the Little Dog) and the Twins, Castor and Pollux, which make up part of Orion's retinue. Almost overhead during winter evenings you will see Capella in Auriga (the Charioteer), which is yellow like the Sun; but whereas the Sun is a dwarf star, Capella is a giant.

Rather low in the north the Great Bear, Ursa Major, is still well above the horizon; over England it never sets, and is unmistakable, even though it contains no outstandingly brilliant star. The two 'pointers' show the way to Polaris, in Ursa Minor (the Little Bear), which lies within one degree of the polar point, and so seems to remain almost stationary.

Take a line from Mizar, the second star in the Great Bear's tail, and pass it through Polaris; on the far side you will see the 'W' of Cassiopeia, another of the famous northern groups. It is a very rich area, because the Milky Way passes through it, and there are many superb star-fields. And over to the west, now not far from setting, lies the Square of Pegasus, the Flying Horse – the leading Autumn group. It too is easy to identify, through admittedly maps give the impression that the Square is smaller but brighter than it really is.

This winter the planets are not so well placed as they will be in the coming months although Venus is still brilliant in the west after sunset, and will remain so until it passes through inferior conjunction in January. Mars, Jupiter and Saturn are all morning objects in the Virgo area. Jupiter is much the brightest of them; Mars will not reach opposition until next March, while Saturn, north of Spica, is regaining its customary beauty as the ring-system opens out.

Finally, did you witness the total eclipse of the Moon on January 9? It should have been readily seen from Europe, cloud permitting; it is always fascinating to watch the lunar face turn a dim, coppery colour as it passes into the shadow cast by Earth.

CHRISTMAS ROUND UP

ALAN McKENZIE, EDITOR OF 'STARBURST' MAGAZINE, LOOKS AT SOME CURRENT RELEASES

Unlike previous years, fantasy is a little thin on the ground this year. Christmas 1978 had *Superman–The Movie* as its centrepiece. The following year saw *Star Trek–The Motion Picture* and *The Black Hole* unleashed upon an unsuspecting World; (were you ready for those?). Last year's big Christmas release was the thoroughly disappointing *Flash Gordon* (though the lovely Ornelia Muti did help make the movie more watchable). I hear Ornelia won't be in the sequel that is planned. (For the Princess Aura role, word is that the producers are trying to make up their minds between *Battle Beyond the Stars'* Sybil Danning and French actress Brigitte Lahaie.) Other 1980 Christmas films included *Battle Beyond the Stars* and *The Shining*.

Which brings us to the movies on show over this holiday period.

Already on release as this is being written is the Orion film *Wolfen*. As far as I can ascertain, the film company which handles the distribution on Orion's behalf, Warner Brothers, had no screening of the movie for magazine journalists and I haven't seen the film. However, *Starburst* writer Phil Edwards states: *"What ultimately lets* Wolfen *down and stops it being anywhere near a genrè classic is the script, credited to (director Michael) Wadleigh and David Eyre"*.

Dan O'Bannon's nasty little horror tale *Dead and Buried* is touted as being from the producers of *Alien*. Granted, O'Bannon did write the original script for *Alien* and, after an alledged battle between O'Bannon, producer Walter Hill (who re-wrote the entire script) and the Screen Writers Guild of America, O'Bannon emerged with sole screenplay credit. I have read portions of O'Bannon's original version and quite honestly it scanned like very bad 1950s science fiction. O'Bannon can argue that that is what he was aiming for. Perhaps he was too successful, even after the Walter Hill re-write. I seem to remember that SF writer A E Van Vogt brought a suit against Fox for copyright infringement. He allegedly claimed that *Alien,* like the earlier SF movie *It! The Terror from Beyond Space,* from which *Alien* borrowed heavily, was just too close to his story *Voyage of the Space Beagle*. But back to *Dead and Buried*.

Watching the film with the advantage of having read O'Bannon's draft for *Alien,* I could believe that this film was by the same script-writer. The dialogue was, bluntly, embarrassing. James Farentino, as the town sheriff, gets some juicy B-movie lines: *"Ah, here comes Dobbs, the town coroner and funeral parlour director!"*

The behaviour of the victims-to-be is nothing short of idiotic. We are subjected to one scene of a couple and their small child, after nearly being pounced on by a horde of shambling zombie types, stop their car and calmly walk into the kind of house that no horror movie fan would go *near!* Not even in daylight. Adding insult to idiocy, the husband wanders off to explore the *cellar,* leaving his wife and child *alone* while the zombies cast menacing shadows over windows.

Unfortunately, the movie is not quite bad enough to be entertaining in the same way that *Plan 9 from Outer Space* is . . . but it comes close.

And on the subject of bad horror movies, Lucio Fulci (you say Loochio Foolchi) has a new gory shocker awaiting release. *The Beyond* is a very nasty film. Little more than a series of very grisly killings, with very little in the way of plot to hold the piece together. I am not a fan of gore movies. I do not revel in a locked-off shot of a woman's face being eaten away by acid . . . Every nail through a skull or face blown away by dum-dum bullets is captured in loving detail by cameraman Sergio Salvatti. If you have a weak stomach, stay away from this one.

The Columbia animated feature *Heavy Metal* is a series of stories patched together from the magazine of the same name. The film *is* entertaining, though appallingly sexist in its approach. Just about every female character finds some excuse – however flimsy – to disrobe and, in the final story, Taarna, the proud female warrior of the title, is made to undergo ritual humiliation at the hands of her male captors. I have the feeling that the film was constructed with the 14 year-old male in mind. Either that or the creators stopped maturing shortly after puberty . .

Still on the subject of animation, the Disney film for Christmas is *The Fox and the Hound*. To be honest (and I apologise to all those at Disney) the movie doesn't have much to recommend it to anyone over 12. A shame, because Disney classics such as *Snow White* and *Bambi* are still strong enough to entertain even the blasè-est of adults. Not that there's anything wrong with the film on a technical level, it's just that the Disney organisation should have learned to be a little more choosey with their scripts by now. Clichè or not, I still

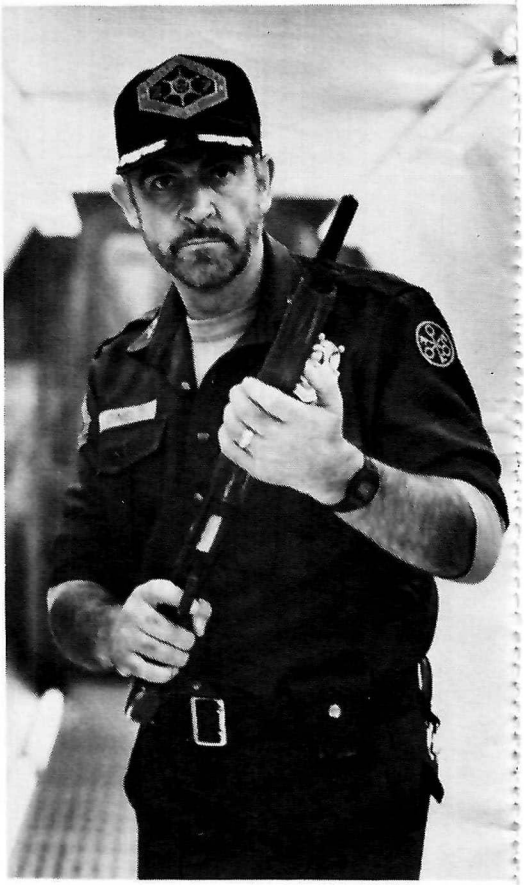
can't help wondering whether Walt would have picked *The Fox and the Hound* as a property for development. Somehow I doubt it!

That just about covers it for the stuff I didn't like. Now we can get on to the goodies. As you read this, John Landis' *An American Werewolf in London* should still be on release in the provinces. Taken as a whole the film is an hysterical look at the British way of life through the eyes of an American (in this case David Naughton, the title star, stands in for director Landis). The film does have a few bloody moments, though not enough to upset too many. The action begins with two American tourists making their damp and windy way through the Yorkshire moors. After an hilarious episode in a local tavern the two set off on their journey again – but are attacked by *something,* leaving Naughton badly mangled and his friend dead. From there on, Landis takes every Transylvanian werewolf clichè and turns it on its head. Apart from a few, annoying, discrepancies, the film scores full marks all the way. (Incidentally, was I the only person in the world to *love* Landis' earlier *Blues Brothers* musical? Answers on a postcard please . . .)

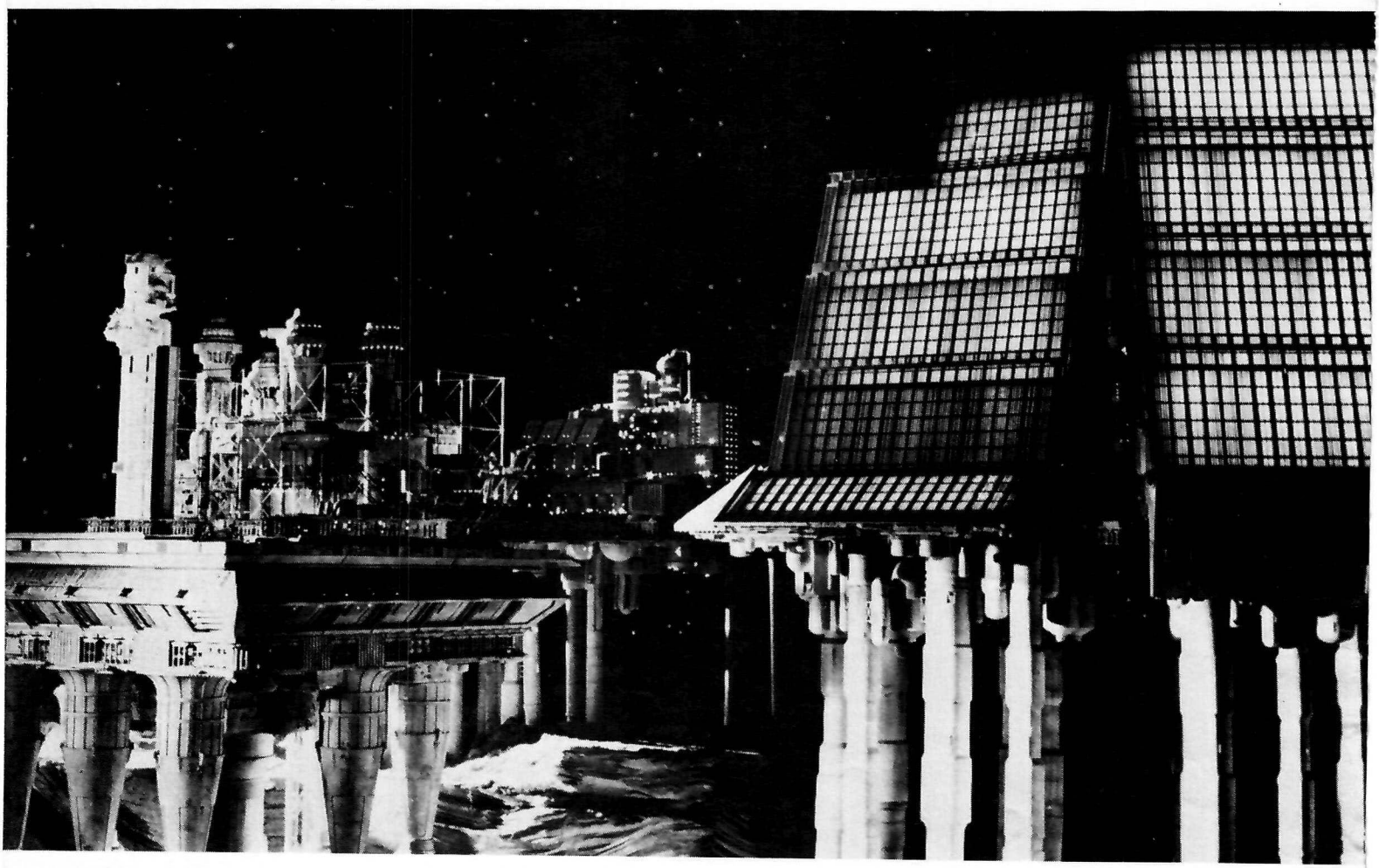
Now to my favourite movie of the holiday period. Originally scheduled for a pre-Christmas release, Richard O'Brien's superb musical fantasy *Shock Treatment* has now been unveiled. The film is a follow-on from the earlier cult success, *The Rocky Horror Picture Show,* but is neither sequel nor a mindless copy. In fact, the film is so good that it is a little difficult to know where to begin praising it.

However, as with *The Blues Brothers,* it seems that I am the only person outside my *Starburst* colleagues who enjoyed *Shock Treatment.* The film has had uniformly bad notices in the United States, something creator Richard O'Brien is less than happy about. When I met O'Brien recently at a party, I mentioned how much the *Starburst* team and I had enjoyed the picture. He didn't appear convinced!

The reason the film has received bad reviews in the States is, I think, because it strikes mercilessly at the very heart of American society. It mocks the American preoccupation with bad television shows. And as *1941* and *The Blues Brothers* proved, the Americans do not like to be laughed at. *Shock Treatment* is set in the TV studio of a small American town called Dentonvale. Although so closely are the lives of the TV stars and the TV viewers interwoven, it is impossible to tell where TV fantasy leaves off and real life begins. The TV studio becomes a microcosm in itself. The studio audience becomes the townspeople. Brad and Janet (of *Rocky Horror* fame) are singled out by blind game show host Bert Schnick (Barry Humphries) to appear on his TV



Right, Sean Connery as Federal District Marshal William T. O'Neil, star of the film Outland. *Below, Con Am 27, a mining complex on Jupiter's volcanic moon Io, dramatic setting for* Outland.
Photos: © The Ladd Company.



programme, *The Marriage Maze*. Janet (played superbly by Jessica Harper) is manoeuvred into admitting that Brad isn't exactly perfect as a husband and from there on is enmeshed in a plot by TV station owner Farley Flavors to turn her into a media superstar and own her all for himself. The musical numbers are dazzling and direction by *Rocky Horror*'s Jim Sharman is nothing short of inspired.

Shock Treatment is British cinema at its best. It is the other side of the coin from the equally excellent, equally British, *The French Lieutenant's Woman*. Both need our support if the British film industry isn't to disappear altogether.

And what of the months to come? The Disney/Paramount co-production *Dragonslayer* opens here soon after a lukewarm reception in the United States. I haven't seen the movie yet so I am unable to comment. The *Star Trek* sequel movie is scheduled to go ahead – with a smaller budget (surprise!) and *Time After Time*'s Nicholas Meyer in the director's chair. President of Paramount Pictures, Michael Eisner, insists that the picture will be a theatrical release, not a TV movie. He also states that both William Shatner and Leonard Nimoy are signed up – despite rumours that Nimoy was holding out.

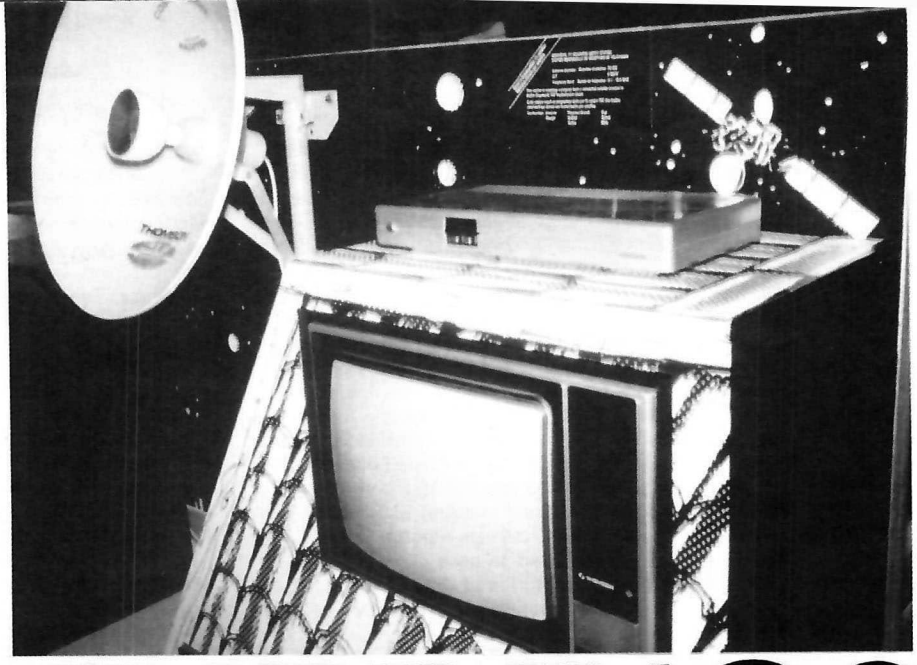
All of which brings us neatly (well, fairly neatly) to the fantasy TV shows lined up for the early part of this year. Over the holiday period, the BBC showed the K-9 special entitled *K-9 and Co*. The show featured Elisabeth Sladen repeating her role as reporter Sarah Jane Smith (who used to be a companion of Jon Pertwee's Doctor) and John Leeson as the voice of the robot doggie; the show was under very heavy security at press time. *Doctor Who* producer John Nathan-Turner inherited the reins of the project almost by default but tackled the project with creativity and gusto.

Still on the subject of *Doctor Who*, it cannot have escaped the attention of any fantasy fan that the new season of *Who* begins this month. Tom Baker, the longest-running Doctor of all, has been retired and youngster Peter Davison steps into one of the choicest roles in British telefantasy. It it also obvious that the Doctor has been getting younger with each incarnation over the past 18 years of the series. The companions from the last season remain: Matthew Waterhouse as Adric, Sarah Sutton as Nyssa (now with trousers instead of skirts) and my own favourite, the gorgeous Janet Fielding as Tegan.

If the previous season is anything to go by, then this year's offerings should be something spectacular. Despite my early misgivings about Nathan-Turner's lack of experience, I am pleased to say that he worked wonders with what had become a dull parody of itself. Nathan-Turner took the formula and gave it a damn good shake. He removed Romana (I thought Lalla Ward's version was a bit wet), K-9 the cute robot dog and finally Tom Baker.

Little is known of the stories for the new season. Nathan-Turner is very nervous of early publicity. It is certain that the Master, played as a slightly more theatrical version of the Roger Delgado original, will play a major role in the series. And there is talk that an old, well-known enemy will return to plague Davison's Doctor and his chums. Any guesses? The Daleks? No way! Contractual problems – Terry Nation owns the Daleks – would make it more trouble than it was worth. Who does that leave? The Ice Warriors? The Yeti? The BBC isn't telling . .

Left, no prizes for guessing the identity of this robot dog, from a well-known BBC series, which will have been seen over Christmas in a special one-off programme! Below, a dramatic scene from* Altered States *which is one of the most intriguing of recent SF films. Photo: © Warner Brothers Inc.



THE RINGS OF EARTH

MAT IRVINE LOOKS AT DOMESTIC COMMUNICATIONS DEVELOPMENT

Arthur C Clarke is quoted as glumly stating that he lost a billion dollars – in his spare time . . . The reason for this citation is, of course, the geostationary or synchronous orbit around the Earth. Hence any object placed in this path will apparently stay in a fixed position. Arthur C Clarke pointed this out in his famous paper published in *Wireless World* during 1945, but never thought to patent the idea – if it was patentable anyway, though this particular orbit is being referred more and more these days as the 'Clarke Orbit', which is probably worth more. The paper was an appropriate article for the magazine; it was a way around the perennial problem of communications worldwide. Most radio signals don't like to travel in curves, high quality VHF and UHF in particular, and just hurtle straight out through the atmosphere only waylaid on their journey to the stars if the Moon happens to be in the way. Some signals can be bounced, using the upper atmosphere, around the Earth, but the quality and band-width suffers. Hence the idea of a communications satellite – a relay station in the sky, receiving the transmitted signal, and re-broadcasting it to another part of the globe. Like most brilliant ideas, it's really absurdly obvious, but of course it took some time and a lot of technology to get anything off the ground – literally. In fact, Arthur had envisaged manned space stations, with transmitters powered by valves, for at the time of the *Wireless World* article, transistors had yet to emerge. It also took some time to obtain the correct orbit. The first active communications satellite – Telstar – was in a very low orbit and, ironically, the first ground stations that were

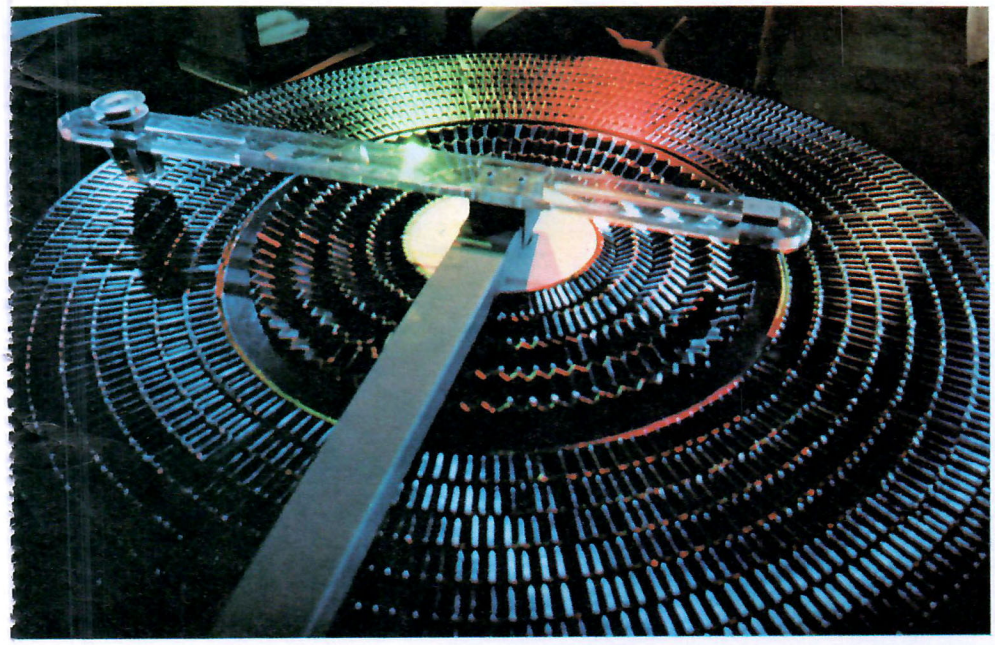
Above, home set-up via direct broadcasting satellite – note aerial and decoder (on top of TV). Photo: Mat.

built at Andover, Maine, Pleumeur Bodou in France, and Goonhilly in England had to be sophisticated enough to track the satellite as it rose over one horizon and very rapidly sank below the other. I personally remember watching the first such transmissions, in fuzzy black and white, and marvelling at the technology. Nowadays we have watched *Apollo* splashdowns in colour, via two such satellites, and without a second thought as to how the picture got half-way around the World.

The last decade has seen an inversely proportional growth in comsat traffic. Telephone calls, telex, broadcasting and business all wing their way across the oceans and continents augmenting the equally-sophisticated submarine cables and microwave links. However, within the last few years, yet another revolution is about to take place, and one which could be potentially the most far-reaching of them all. Only with a communications satellite in geostationary orbit have you the means of broadcasting *directly* to an individual, anywhere within that satellite's footprint. At present, giant dish transmits to, and receives from, giant dish and only after that does the domestic consumer get his hands on it, for the major usage, as far as broadcasting is concerned, is just the most efficient way of getting a high quality colour TV picture around the World. When you have the facility of broadcasting directly into someone's home, it is a completely different ballgame.

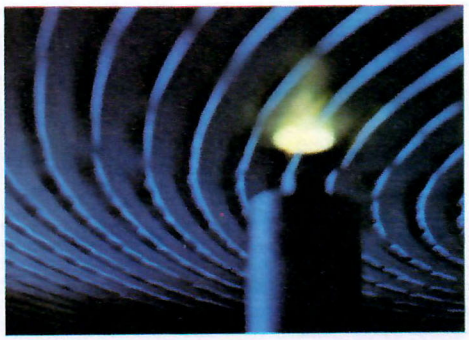
Propaganda is the inevitable 'red-herring'; we'll be showered from out of the sky with broadcasts we don't want. Well, there's two easy answers to that: 1), everyone has been subjected to radio propaganda for years and 2), switch it off!

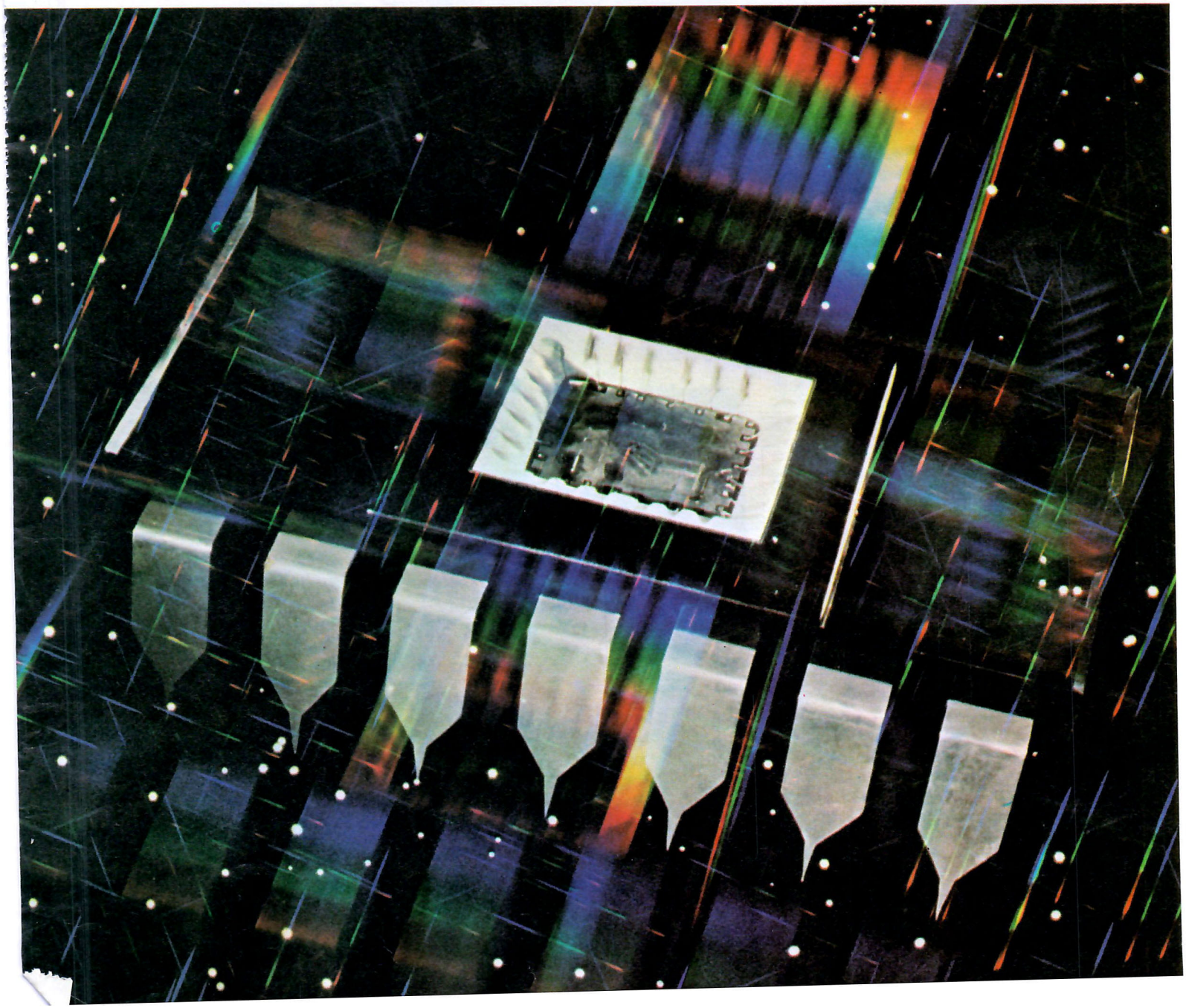
On the more positive side, experiments have already been taking place in countries such as Brazil and India for direct broadcasting to remote regions with educational programmes. Perhaps not into each individual mud-hut, but at least to a communal receiver per village. These experiments occurred several years ago, involving the very powerful comsats such as *Intelsat 4* and *ATS 6*. Since then other countries, rich and poor, have had their own domestic comsats launched. Canada uses the *ANIK*; a system first launched in 1972 to broadcast to remote regions and relay business data and telephone calls. The US has the *Satcom, Comstar* and *Weststar* series of satellites, transmitting all types of telecommunication data. Eastwards, Indonesia took the giant step of ignoring ground-based transmitters and going directly to a comsat – *Palapa*. *Arabsat* is planned and Japan, not surprisingly, is also heavily into Direct Broadcasting. Possibly some of it has to do with prestige; there's nothing quite like launching your own satellite to make your neighbours sit up and take notice, for if economics are taken into account, ground stations are cheaper to install – even given that you may need 10 00; and can be maintained and also last a long time. Conversely satellites are still fairly costly, if they go wrong you can't (yet) repair them and they can be maintained and also last a long time. Conversely, satellites are still fairly costly, However, satellites are quicker to get under way, and with a rapidly growing Third-World country, this I suspect is the primary reason. In



Video disc mock-ups. Left, RCA and JVC systems and below, the Philips Laser Vision. Our article has, thus far, managed to avoid mentioning 'Micros' but the author is fully aware of the revolutionary importance of this minute silicon chip. At foot, our tribute to this tiny piece of micro-wizardry, a stylised microprocessor in orbit.

Photos: Mat





Europe the lead was taken by Germany and France with their joint *Symphony* satellite, used for experimental broadcasts. Britain as usual is late, a fact all the more ironic as we were among the first three countries to have a ground station, and through BAe have more comsat expertise than any other country outside the USA. However, all is not lost for, through ESA, BAe is the prime contractor for comsats in Europe and their home-grown OTS (Orbital Test Satellite).

OTS was launched in 1978 and has since been used for a multitude of experiments in different types of broadcasting. The satellite is the first of a system of European comsats, based on the OTS bus with different antennae for different missions. Culmination is with *L-Sat* which will be the first true Direct Broadcast satellite in Europe; able to put a signal directly into any household with the appropriate receiver and dish antenna of a size not larger than a metre and probably smaller.

So we enter a new era in the field of broadcasting, but a question that doesn't appear to get asked all that often is, 'With all this high-tech. hardware, what are we actually going to watch?'

Unfortunately it could be that Britain loses out again for however much we complain, 'Auntie Beeb' and 'Uncle IBA' still produce the best broadcasting around the World – and that's not me saying so, that's the rest of the World; Having seen some of the results of the rest of the World I'm inclined to agree with them . . .

So we could be in the silly situation of being bombarded from the ether with hundreds of programmes, none of which we'll want to see. In consequence we come to the other side of the high-tech. coin – which is even more imminent than Direct Broadcasting – the world of the video home entertainment industry. Someone realised that the general public would like a choice from that provided over the air-waves. In a very limited way, cable television had provided an alternative, though only in limited areas, and if you were a movie buff you could always buy an 8mm copy of highlights of the latest cinema blockbuster. However, it needed a different approach and that was going to arrive with a resounding crash in the mid 1970s.

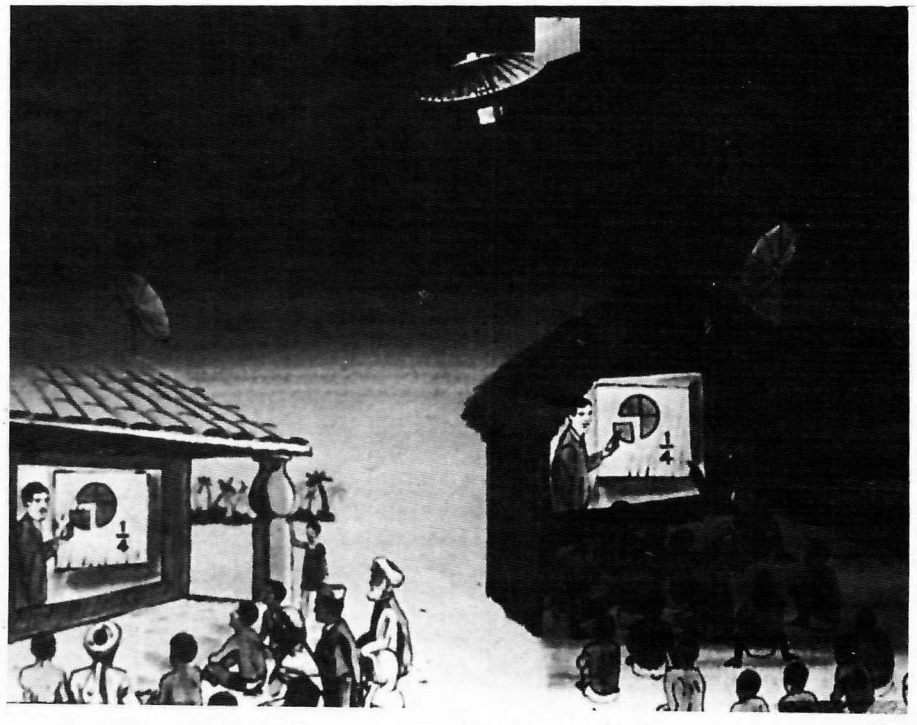
It began on a stop-start basis with **Philips** and their 1500 VCR series, a domestic video cassette recorder capable of recording and playing back a transmitted TV programme. The early machines were plagued with probably more than their fair share of faults. The cassettes were of the stacked type (one on top of the other) and originally played for only one hour. However if you got a good machine, correctly set up, the picture quality was regarded by many to be the best that's been obtained from a domestic unit. The system is now obsolete, but many are probably still giving valuable service.

Meanwhile in Japan, the big electrical companies were not slow to realise things were happening. Two of them, **Sony** and the **Japanese Victor Company,** began developing their own systems independently and these have become the mainstays of the home video market around the World. Sony developed the *Betamax* system, and JVC, the *VHS*. Both had advantages over the Philips 1500 VCR and so they retaliated with the 1700 series. This *looked* identical, but the tape ran at half the speed. The problem wasn't eased either by **Grundig,** who brought out their own version of the VCR, the SCR, which again used similar cassettes but wasn't compatible with either of the Philips' systems. Philips, along with Grundig, have decided to join forces in an attempt to combat the Japanese invasion and have come up with a fourth system, the 2000 series. Here both makes are compatible for once, though of course not with Betamax or VHS. So the situation at present is three current domestic video systems, all incompatible and all with their pros and cons.

If all the foregoing wasn't enough, the latest in video technology is the Video Disc.

Analogous (or should it be digitalous!) to the audio disc, the video disc *cannot* be used for home recording, just for playing back pre-recorded material, but has the definite advantage of higher quality and the dubious estimate that it's cheaper. Of course everything comes in threes and so there are three video disc systems; Philips' *Laservison,* the most sophisticated; RCA's *'Selectavison'* and JVC's *VHD*. It goes without saying that all three systems are incompatible and all are in their infancy. All three could be used for very high quality, multi-sound reproductions, but only JVC are making this point with their audio AHD system. Whether all three will survive, only time will tell and, for that matter, whether the video disc concept will catch on in the same way that the video cassette market has. Possibly the consumer will decide that a slightly lower quality machine, with the advantage that it can record as well, has more things going for it than a machine which at present estimates will not be much cheaper, and can only play back. Having said that, there are experiments taking place with a video disc system that *will* record!

If that isn't enough to boggle the brain, these are not the only items you can plug into your telly. The simple tennis games that arrived in glorious black and white not that long ago have been superseded by a complex mass of computer-generated entertainments from golf to Space Invaders with colour, sound and enough instructions to satisfy a shuttle pilot. Then to keep track of your home finances, or just to play more games, you can plug in your *Apple, PET* or *Sinclair* home computer to join ranks beside the *Prestel* terminal and the *Teletext* selector. Add to that the near future of colour video being recorded on something no larger than an audio cassette and the audio side coming in full stereo from a micro-cassette then what next? One hesitates to ask. Complete audio-visual experiences encapsulated in a holographic medium is a possibility or, alternatively, how about sitting in a deckchair with a book?



At right, an example of educational broadcasting, via ATS, to Third World countries. Above, a wrist comsat – the ultimate in direct communication, the technology for which exists now. The military use a larger (back-pack type) version to enable soldiers to pin-point their position to the nearest metre! Photo: Mat.

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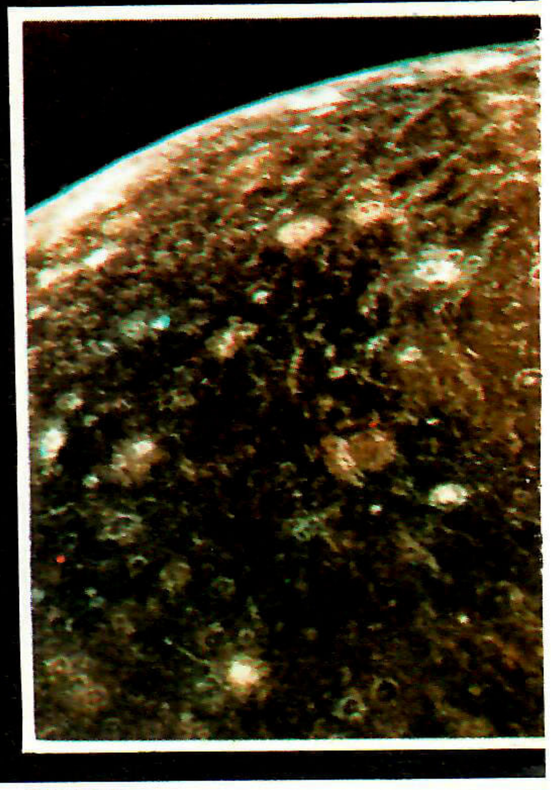
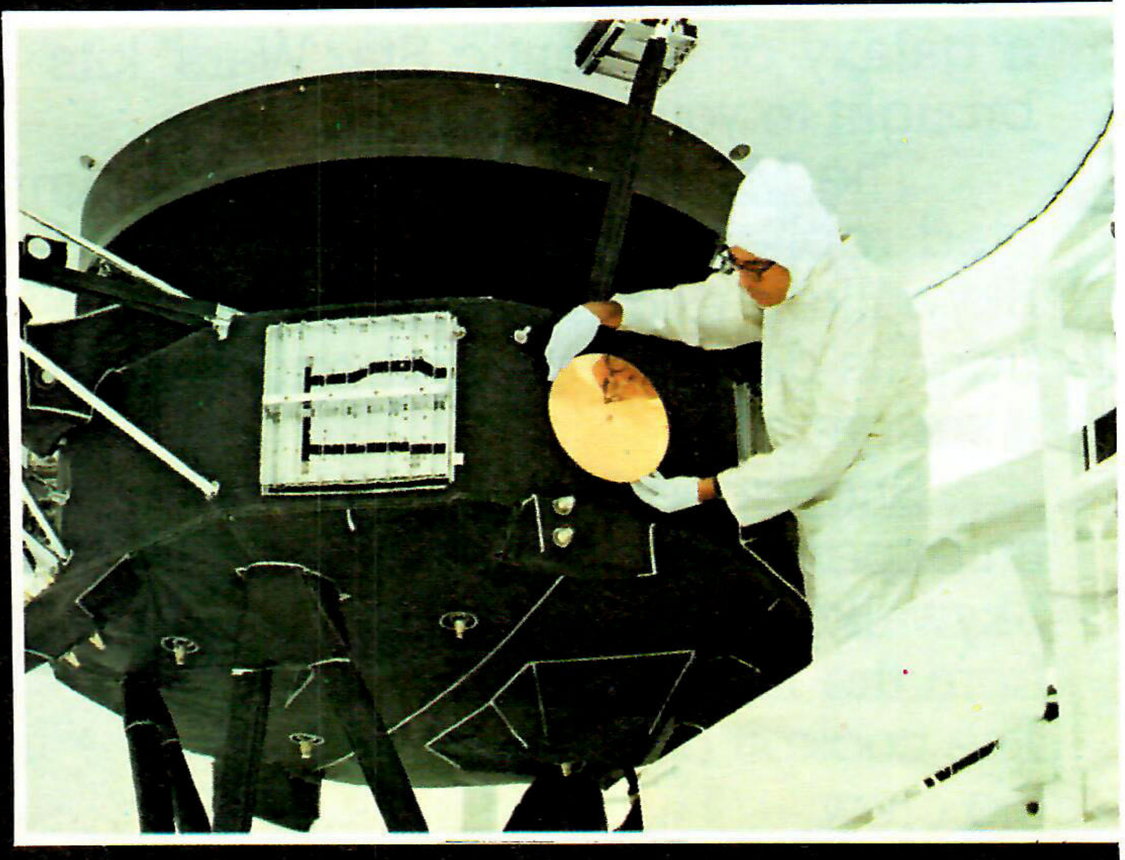
VOYAGER -THE STORY SO FAR

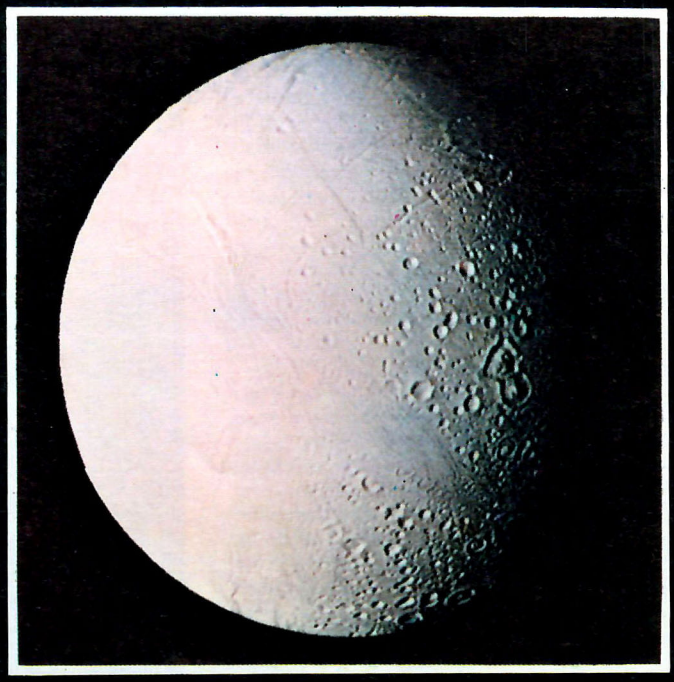


MAT IRVINE

Launched out into the immensity of space went four tiny craft. Frail structures put together by dedicated men and women on an insignificant World circling an average star out on the rim of a galaxy. Their mission was to explore other worlds nearby, distances measured in mere millions of miles. However, these chosen four were different from the many other craft launched by this world. The paths in which they could travel, and the speeds they would attain, would mean that they would pull free of the tenuous gravitational grip of their solar system and eventually cross its undefined barrier and head out towards other stars.

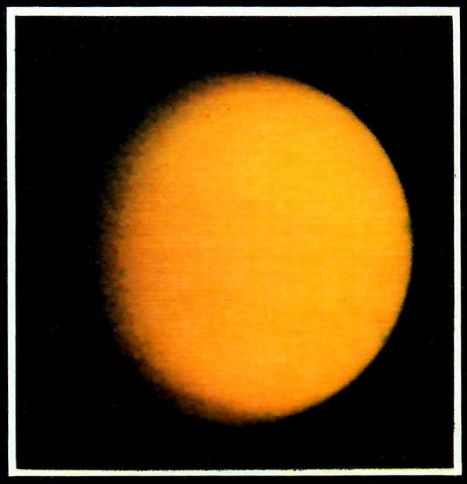


Voyager 1 photo of Jupiter and two of its satellites, Io (left) and Europa.



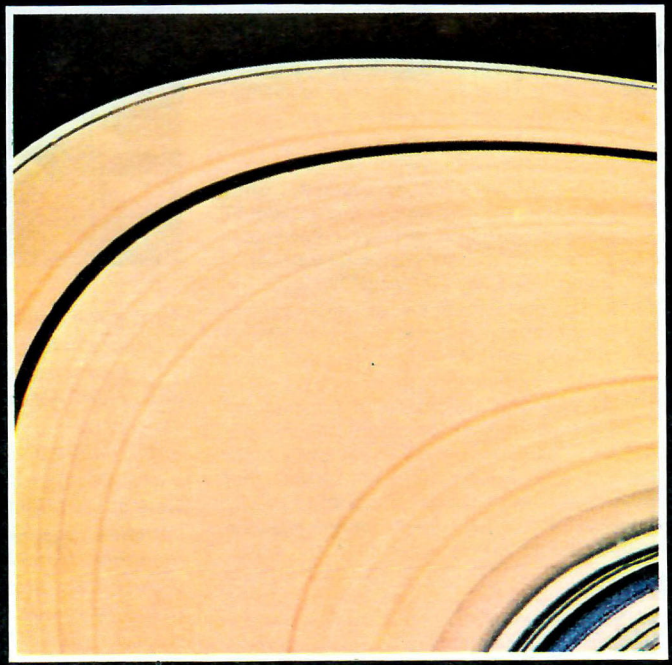
Left, Voyager 2's composite picture of Enceladus taken on August 25, 1981 from a range of 74 000 miles. Below left, the fantastic A-ring of Saturn; special filters were used to enhance subtle colour differences between the rings. Below, two satellites of Saturn; Titan (uppermost) and Iapetus.

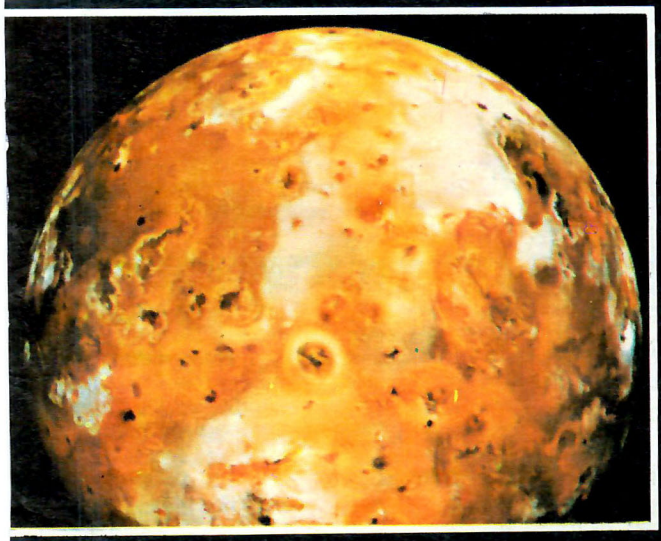
Photos: NASA

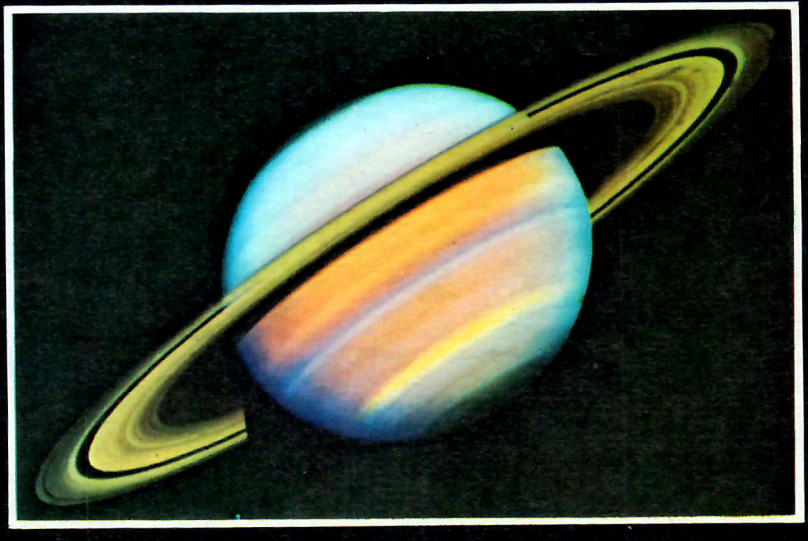


Below, the surface of Callisto, one of Jupiter's satellites, taken by Voyager 1 in 1979. Bottom row. Left, the 'Sounds of Earth' record is mounted aboard Voyager 2 prior to encapsulation in its protective shroud. Centre, close-up of Io taken at a range of 500 000 miles by Voyager 1. Right, unusual image of Saturn made up of three images taken through ultraviolet, violet and green filters.

Photos: NASA







Launched two weeks apart in the late Summer of 1977, on top of the giant Titan 3E Centaur rocket, the planetary probes, *Voyagers 1* and *2*, had started on a journey that has, to date, lasted over four years and potentially could go on for ever. The Voyager probes – with the Viking craft – are probably the most sophisticated and advanced unmanned spaceships launched. Designed and built by the Jet Propulsion Laboratory at Pasadena, California for NASA, they combined the best aspects of the two earlier types of American planetary craft – *Pioneer* and *Mariner*. In fact the Voyagers were originally called Mariner Jupiter/Saturn and Mariner Jupiter/Uranus, signifying the initial targets for each craft. As the mission profile changed, a new name was thought appropriate and the Voyagers were born.

Advanced as the craft themselves are, they represent the remains of a much grander mission, known as the Grand Tour. Because of the vast distances involved, specially when contemplating journeys to the outer planets, a slingshot technique is used to 'fling' the craft around the giant planets and onto the next, a sort of interplanetary billiards. This can only be done when the planets are in a suitable alignment, which they have been for the last few years, and will not be again for many decades to come. Voyager was the last chance to grab at the opportunity of a mini-Grand Tour.

The Voyagers' tasks were to explore, at close quarters, the giant planets of the Solar System – Jupiter, more massive than the rest of the planetary system put together, and which some scientists liken to a failed star; and Saturn, probably the most beautiful of planets with its incredible ring system – though just how incredible had to wait until the first probe encountered the planet at close quarters.

Their earlier companions, Pioneers 10 and 11, had given us a glimpse of what could be expected. Their camera systems gave pictures far better than any ground-based telescope, but if they were good, the Voyagers' imaging systems were a 100 times better.

Voyager 1 reached Jupiter in March of 1979, five and a half years after the pictures sent back by Pioneer 10. The detail seen is emphasised in the photographs reproduced here. Jupiter was known to have a colourful atmosphere, but even allowing for the fact that the pictures are entirely electronically produced, and computer enhanced, the range of colours surprised practically all the scientists. Here was a planet that was one big weather system – a particular delight to the only 'foreigner' on the Voyager Imaging Team, Dr Garry Hunt of University College London, whose speciality is planetary atmospheres and meteorology. By studying the completely different weather conditions on the alien world, it can actually lead us to a better understanding of our own climatic conditions.

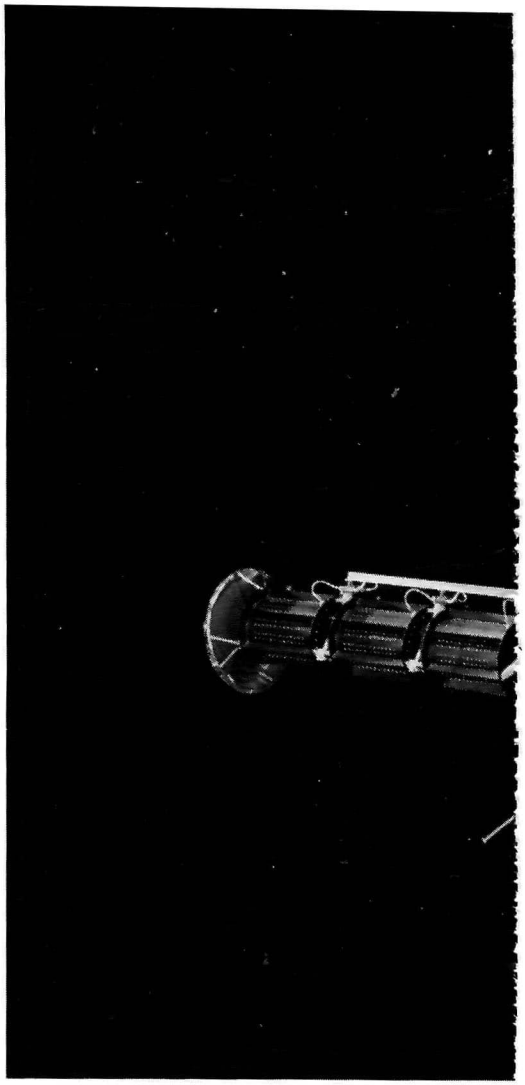
Besides the multi-coloured aspect, Voyager 1 also had a few more surprises. Particularly, a close-up look at the only constant feature on the face of the planet (not surface, for Jupiter doesn't have a surface as such – it's virtually all atmosphere.) The Great Red Spot has been known for centuries, but the Voyager pictures revealed it as a gigantic rotating storm, large enough for the Earth to fit comfortably inside. Other smaller, but similar features, were also seen and lightning flashes observed. And that was just the planet itself. Jupiter possesses a large retinue of satellites, including the four so-called Galileans – Ganymede, Io, Europa and Callisto. All turned out to be different and, with Io in particular, one of the major highlights in an already overwhelming scientific extravaganza, was the discovery of another body in the Solar System, besides the Earth, to have active volcanos. As a final parting gift, as Voyager 1 left the Jovian system, it discovered that Jupiter too has a ring, albeit a thin, rather unspectacular one, but it's there. (Rings around the planet Uranus were discovered in 1977 by stellar occultation experiments from Earth actually designed to observe the planet's atmosphere, rather than to discover any rings!).

Meanwhile the Pioneer probes were still travelling. Pioneer 10 was being gravitationally slung out of the Solar System by the Jovian gravity, set to cross the path of Pluto, and hence leave our Solar System, in 1987. Pioneer II, though, was to encounter Saturn in September 1979, six months after Voyager I's encounter with Jupiter and gave us, on Earth, the first close-up pictures of the second largest planet. The quality was adequate but now it was known what Voyager could do and so it was a 14 month wait until the more advanced probe could also reach the ringed planet.

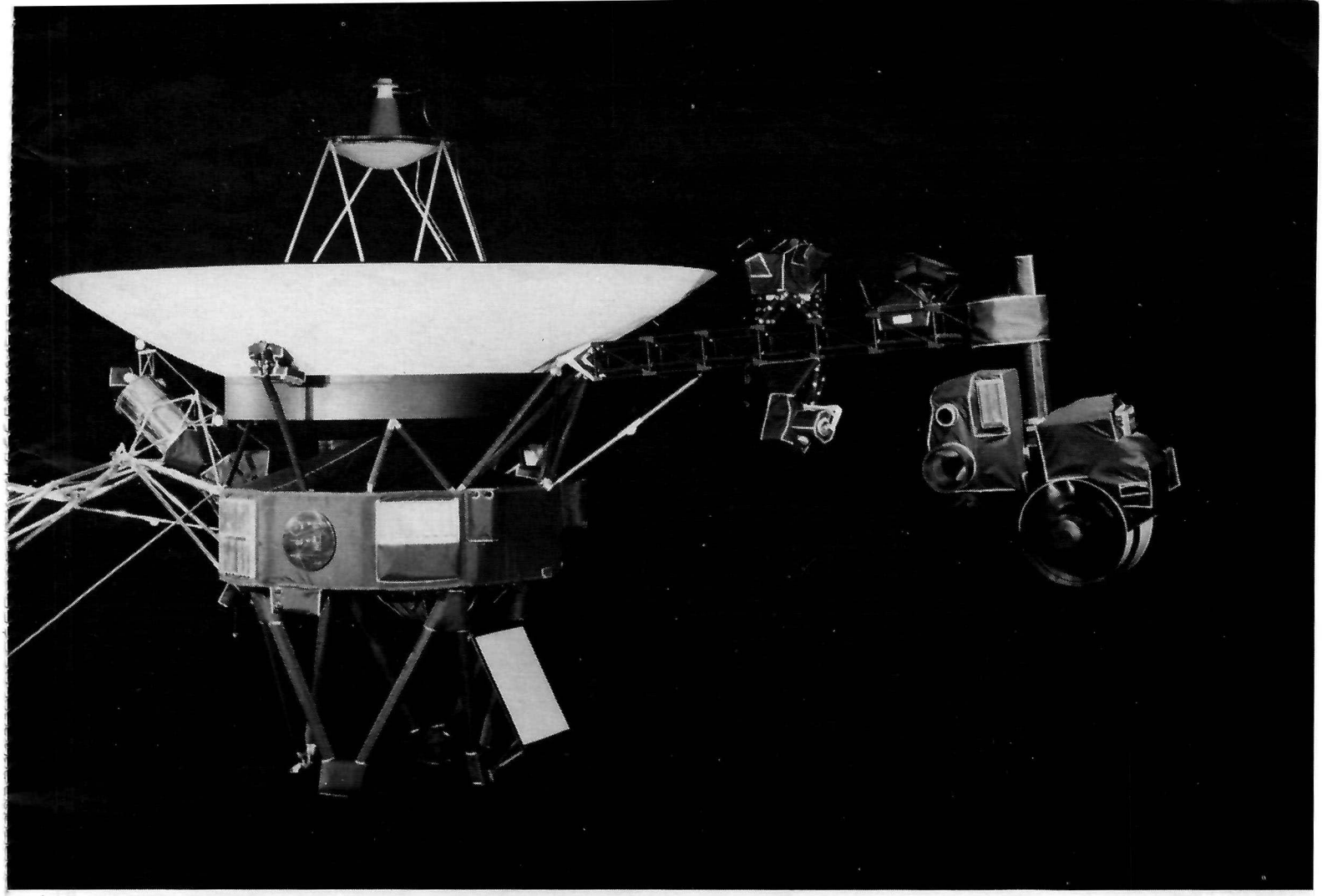
Voyager I reached Saturn in November 1980 and 2 arrived in August last year. Between them they photographed the planet itself and most of her retinue of satellites, discovering a few more in the process. Saturn, herself, turned out to be less colourful than Jupiter, but the ring system is more complicated than anyone suspected. After Pioneer's, visit, the ring system was thought to comprise of six individual rings, some much more prominent than the rest. After Voyager 1, everything changed. The gaps between the rings, the most prominent of which are the Cassini and Encke divisions, known from Earth observations, are not in fact gaps, but really rings with less material in them. Rings, such as the wide B ring, are made of hundreds of smaller rings making the system much more complex than anyone dreamed. Even more baffling was the discovery of 'spokes' that rotated around the rings. The laws of gravity forbid them to be solid, for the ends nearest the planet should rotate faster than the outer. Supposition is that they are formed of electrically-charged dust actually above the ring surface itself. And yet another mystery was the braided F-ring, seemingly tying itself into knots in places with two newly-discovered satellites, 1980S26 and 27, orbiting alongside and shepherding the ring into these odd patterns. More satellites were also discovered in joint orbits. 1980S1 and 3 share an orbit, while the larger, known satellite Dione also has a companion 1980S6, now more usually called Dione B, travelling at 60° ahead. Tethys goes one better and has two companions, 1980S13 in the 60° ahead position, and 1980S25 60° trailing.

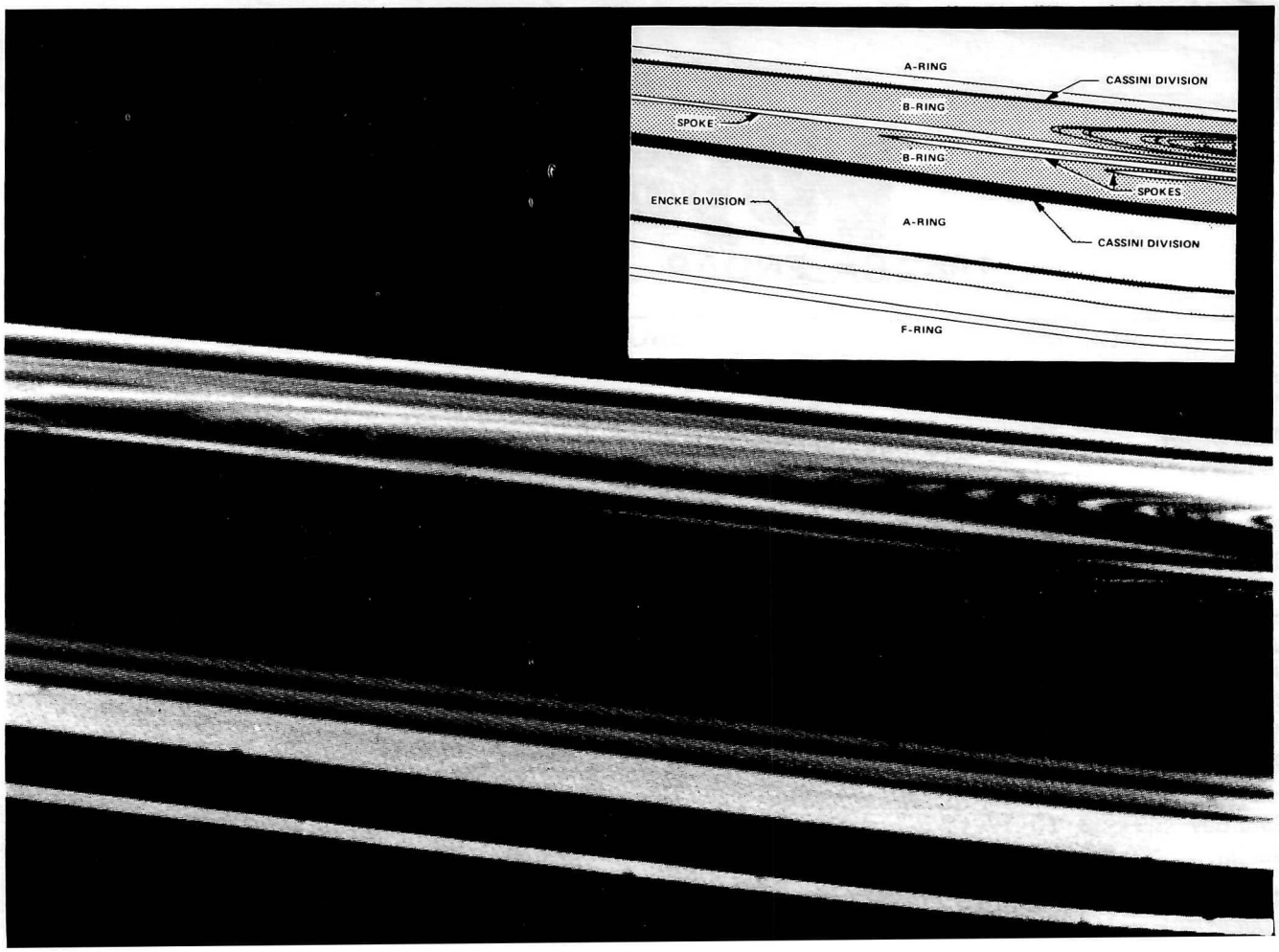
Most tantalising, though, must be the pictures of Saturn's largest satellite, Titan. Originally thought to be the largest in the Solar System (now beaten by Ganymede), Titan still has the distinction of being the only satellite with an atmosphere, an atmosphere so dense that all Voyager could see was the orangey cloud tops.

What lies beneath is still a mystery, though it is now known, from Voyager measurements, that the atmosphere is not mainly methane as had been discovered from Earth observations. Titan has, in fact, a mainly Nitrogen atmosphere, with methane making up probably only 1%. The vague hope that Titan may support some kind of life now seems unlikely. The temperature is down to −200°C, making the nitrogen a liquid at the surface of the moon and, all in all, probably fairly inhospitable. But it may be that not all hope is lost. The chemical traces that existed in the early Earth's soupy atmosphere appear to be present in Titan's, and so, to quote Garry Hunt, perhaps Titan is the Earth in a deep freeze. Should the thaw ever come, maybe something will develop. There's probably a long wait, though, and by that time the Voyager probes and their messages will be well on their way to the stars.



Above, the Jupiter/Saturn Voyager spacecraft weighs 795kgs (including 113kg of scientific instruments) and is one of NASA's most spectacular successes.
Right, before diving below Saturn's ring plane, Voyager 2 captured this oblique view of the bright (northern) side of the complex rings. The angle highly magnifies features near the bottom of the picture and compresses features across to the other side of the west ansa (the western edge of the loops in the rings). Photos: NASA




A-RING
CASSINI DIVISION
B-RING
SPOKE
B-RING
SPOKES
ENCKE DIVISION
A-RING
CASSINI DIVISION
F-RING

SPACE Voyager

1982 CALENDAR. JANUARY – JUNE

JANUARY					
Monday		4	11	18	25
Tuesday		5	12	19	26
Wednesday		6	13	20	27
Thursday		7	14	21	28
Friday	1	8	15	22	29
Saturday	2	9	16	23	30
Sunday	3	10	17	24	31

FEBRUARY					
Monday	1	8	15	22	
Tuesday	2	9	16	23	
Wednesday	3	10	17	24	
Thursday	4	11	18	25	
Friday	5	12	19	26	
Saturday	6	13	20	27	
Sunday	7	14	21	28	

MARCH					
Monday	1	8	15	22	29
Tuesday	2	9	16	23	30
Wednesday	3	10	17	24	31
Thursday	4	11	18	25	
Friday	5	12	19	26	
Saturday	6	13	20	27	
Sunday	7	14	21	28	

APRIL					
Monday		5	12	19	26
Tuesday		6	13	20	27
Wednesday		7	14	21	28
Thursday	1	8	15	22	29
Friday	2	9	16	23	30
Saturday	3	10	17	24	
Sunday	4	11	18	25	

MAY						
Monday		3	10	17	24	31
Tuesday		4	11	18	25	
Wednesday		5	12	19	26	
Thursday		6	13	20	27	
Friday		7	14	21	28	
Saturday	1	8	15	22	29	
Sunday	2	9	16	23	30	

JUNE					
Monday		7	14	21	28
Tuesday	1	8	15	22	29
Wednesday	2	9	16	23	30
Thursday	3	10	17	24	
Friday	4	11	18	25	
Saturday	5	12	19	26	
Sunday	6	13	20	27	

STARBIRTH: in gas clouds like this great Orion Nebula, stars may be born as depicted in this dramatic painting by David A. Hardy

SPACE Voyager

1982 CALENDAR. JULY – DECEMBER

JULY					
Monday		5	12	19	26
Tuesday		6	13	20	27
Wednesday		7	14	21	28
Thursday	1	8	15	22	29
Friday	2	9	16	23	30
Saturday	3	10	17	24	31
Sunday	4	11	18	25	

AUGUST					
Monday		2	9	16	23	30
Tuesday		3	10	17	24	31
Wednesday		4	11	18	25	
Thursday		5	12	19	26	
Friday		6	13	20	27	
Saturday		7	14	21	28	
Sunday	1	8	15	22	29	

SEPTEMBER					
Monday		6	13	20	27
Tuesday		7	14	21	28
Wednesday	1	8	15	22	29
Thursday	2	9	16	23	30
Friday	3	10	17	24	
Saturday	4	11	18	25	
Sunday	5	12	19	26	

OCTOBER					
Monday		4	11	18	25
Tuesday		5	12	19	26
Wednesday		6	13	20	27
Thursday		7	14	21	28
Friday	1	8	15	22	29
Saturday	2	9	16	23	30
Sunday	3	10	17	24	31

NOVEMBER					
Monday	1	8	15	22	29
Tuesday	2	9	16	23	30
Wednesday	3	10	17	24	
Thursday	4	11	18	25	
Friday	5	12	19	26	
Saturday	6	13	20	27	
Sunday	7	14	21	28	

DECEMBER					
Monday		6	13	20	27
Tuesday		7	14	21	28
Wednesday	1	8	15	22	29
Thursday	2	9	16	23	30
Friday	3	10	17	24	31
Saturday	4	11	18	25	
Sunday	5	12	19	26	

ICARUS: from beyond the orbit of Mars, this vivid asteroid glows as it passes close to the Sun. Painting by David A. Hardy.

ALIEN

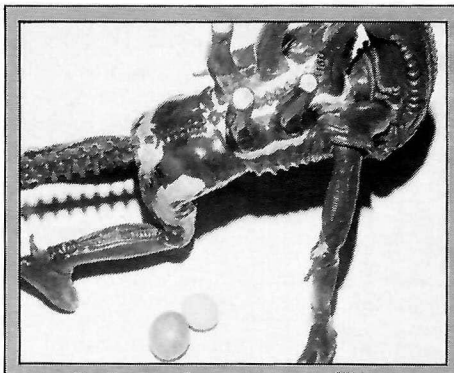
IN SPACE NO-ONE CAN HEAR YOU MODEL

IT now seems obligatory that every major film release spawns a host of supportive tie-in merchandising, especially in plastic kits, and the large range of *Star Trek, Star Wars* and *Battlestar Galactica* models attests to this. *Alien,* however, lagged behind a little by comparison but then who'd want a replica 'chest burster' anyway? After the release of the film, **MPC**, who seem to have somewhat of a tight monopoly on 'Star Wares', managed to come up with the adult Alien form and an uglier plastic kit would be difficult to imagine. It stands nine inches tall, has a transparent carapace plus swivelling arms and head, although its stance, as moulded, looks a little silly. As with its full-size counterpart, seen as a whole the creature is not quite so loathsome and much more effective when most of it is hidden from view.

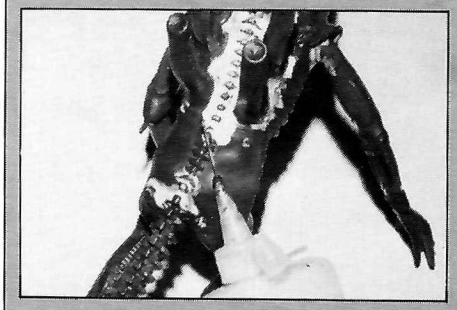
The Model

Construction of the kit could hardly be simpler, there are less than two dozen parts after all, and even the most novice builder should not encounter assembly problems. We chose to ignore the construction sequence, for reasons which we hope will become clearer later on, and assembled the body and arms first. The moulded pose looks too contrived and so consideration was given to altering it. The easiest method is by holding the joints, *ie,* knee, elbow, ankle, over a mild heat source, waiting until the plastic is pliable, then bending the part to the desired position. Obviously some holes may appear but these can be filled in by **Milliput** – a two pack epoxy filler which is a superb medium for remodelling and sets rock hard. Using the heat method, we altered the tail curve and clenched one of the hands for maximum effect. Complete assembly of the model with the exception of the tongue unit (*Parts 1* and *2* of the kit's **Stage 1**) and the transparent head carapace. The pegs to retain the 'movable' arms were discarded as was that on the creature's neck; mating surfaces were then cut and reamed out so that the arms adopted a spread-out attitude and the head sat lower into the body. What took place next is best revealed by our photo sequence:

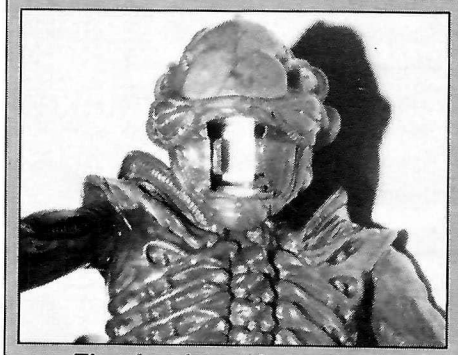
MODEL PROJECT
BY RAY RIMELL



***1** Quite a few gaps will appear around several joints; remember the idea is for the model to appear as one piece overall. All joints were filled with Milliput – note putty and hardener awaiting mixing at foot of picture – and pressed and smoothed into place. Drying time is lengthy so, like Giger himself, you have the opportunity to sculpt. The more the filler can be worked in now, the easier it will be later, for filing set Milliput is quite an arduous task and with all these complex shapes, a headache best avoided.*



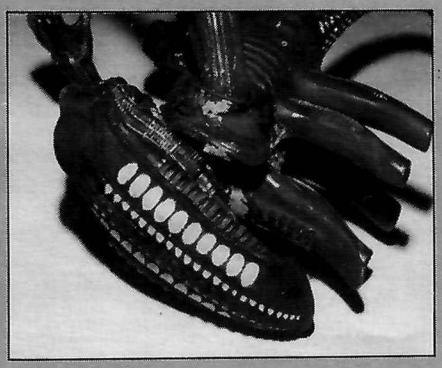
***2** When the filler has dried, sanding it down takes place and this may well take some time; perhaps a sharp knife may be required in some areas. Once this has been done, give the model a few coats of liquid polystyrene cement overall to seal the filler. Follow up by coating all filled areas and joints with PVA wood glue which should ensure the model looks 'as a whole' by giving it a uniform appearance – leave to dry for at least 24 hours.*



***3** The head needs some careful attention; in particular ensure that all joint lines are rendered invisible by careful sanding. Plastic card was used to fill in the roof, floor and back of the mouth cavity and act as a base for the*

Milliput. All teeth were removed as were those from the tongue which was added later.

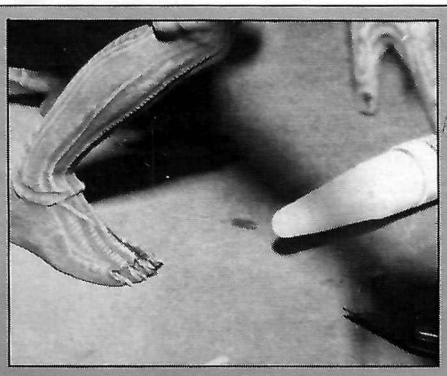
4 The head area under which the clear carapace is to fit should be painted at this stage and a coat of matt dark grey enamel is applied and left to dry. Mix up a creamy green colour using Pelikan Plaka water-based paints and brush carefully over the enamel primer – a smooth mattish finish will result.



5 The Plaka paints are now mixed to achieve a medium green-blue colour and applied carefully over the head leaving the indented moulded detail in the base colour as seen here. Some slight retouching may be required at a later stage before the head cover is finally cemented in place.

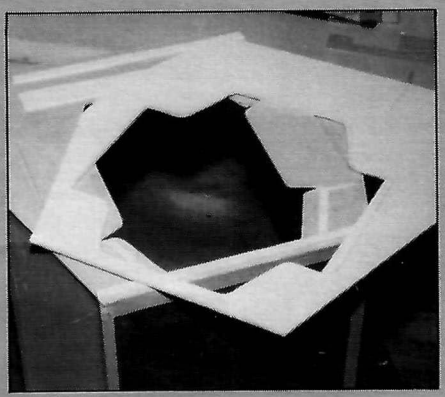
Clean up the joins around the clear part, filling and sanding as necessary. The model can now be sprayed, or airbrushed, overall in dark grey matt enamel, checking photos when it comes to the head. Only the rear, sides and part of the front of the clear part need to be oversprayed; check out movie stills to see the extent of this. When dry, paint over in the Plaka green-blue mix and leave to set.

To make the model more lifelike and to bring out the moulded detail, mix in some white with the base colour and 'drybrush' over the entire figure. The technique is simple. Using the lighter colour, barely fill the tips of a flat chisel brush, stipple out the excess on a piece of scrap card, then lightly 'flick' over the model, stippling it, so the colour just catches the top of the moulded detail and highlighting it.

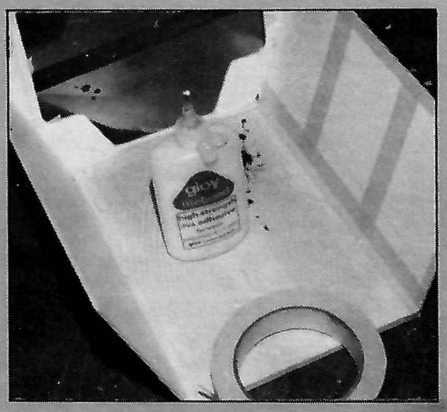


6 For the claws (and teeth) we used the real thing – well, almost. Actually they're the ends of fish bones! To fit them, small grooves must first be made and it's a simple matter to form these with the tip of a heated pin; the melting action forming a positive location. The cut tips of the bones are pushed in place with tweezers then secured by dabs of epoxy glue.

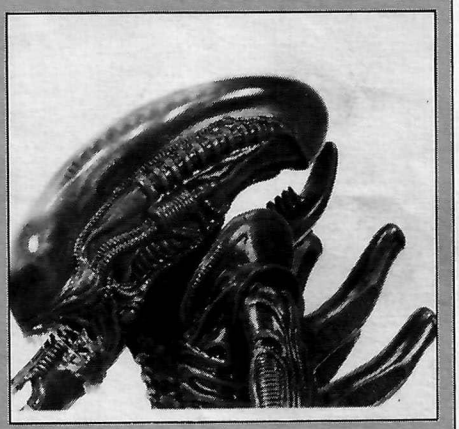
7 New teeth next; replacements from thin scrap plastic suitably scored and trimmed are later flanked by curved bones. Milliput is forced into the jaw cavity filling all the gaps and the teeth installed before it hardens – but paint the jaw first! Finally secure the teeth with 'Superglue' and check with photos for the right number.



8 A suitable backdrop was prepared from thick card cut to represent a typical Nostromo corridor. It needn't be too complicated but the floor, preferably hardwood, will look better for some kind of grid. Exposed edges of the card can be faced with draughting tape prior to final assembly and painting; the latter best accomplished by matt white cellulose primer.



9 The floor of our corridor section is made up of fine mesh Plastic Padding sold in auto shops for car bodywork repairs. PVA is used to glue the card sides together and tape conceals all the joints. After painting, the base can be brought to life with coloured tape, Letraset numbers, coloured lenses, etc.



10 One of the more fun(?) aspects of modelling Alien is reproducing the dripping jaws. First the model is given three coats of clear varnish which are left to harden. The 'saliva' is formed from any clear adhesive with a tendency to string and the dribbles from dollops of epoxy. The more you pile in here the more ghastly the model will look; the object of the exercise in any case. With the above alterations and additions, plus any others you think we may have missed, the model becomes a startlingly realistic replica especially if suitably photographed under colour filtered lights.

Publishers' note:
Since this feature was written, MPC have deleted the Alien kit from their current listings and therefore the model is no longer widely available. Some of the smaller hobby or toy shops may have a few left if you are prepared to search them out.

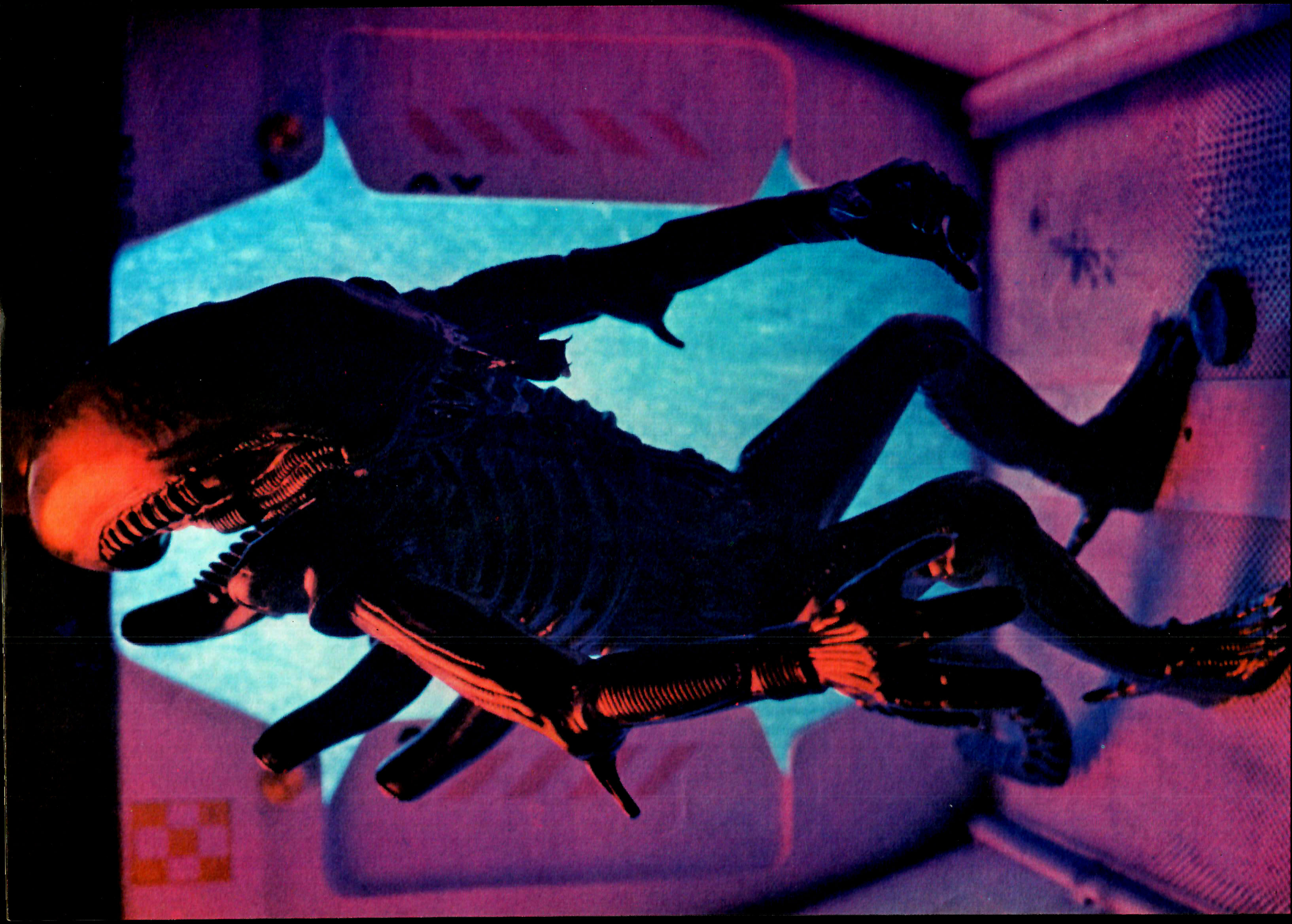


Photo: Ray and Steve

SPACE MODEL SURVEY

UPDATED PLASTIC KIT LIST BY MAT IRVINE AND ANDY YANCHUS

The first article of this kind I penned was for SCALE MODELS magazine in 1974. It took the form of a round-up of all the space-orientated kits that had ever been issued to date. I thought at the time that I'd probably missed some, though exactly how many didn't emerge until a few weeks after publication when I received a letter from a gentleman in New York, by the name of Andrew P Yanchus, who set me straight as to just what I had omitted from that first attempt.

Since then Andy and myself have been in regular contact (although to date we've never met!) and kept one another supplied with all those goodies that were slow to find other routes across the big pond. This led to more articles, filling in the gaps, and regular reviews of varying standards by myself for SCALE MODELS to keep the subject up to date.

I worked on further Space Model lists, culminating in a fourth edition which had a limited publication in February 1977. The listings themselves ran to seven sides, though of course they didn't contain two of the biggest space items to hit the World – the Shuttle and *Star Wars*..

This survey hopes to rectify the situation and has itself led to more problems, especially with regard to Japanese kits! In the fourth edition I pointed out that it was extremely difficult

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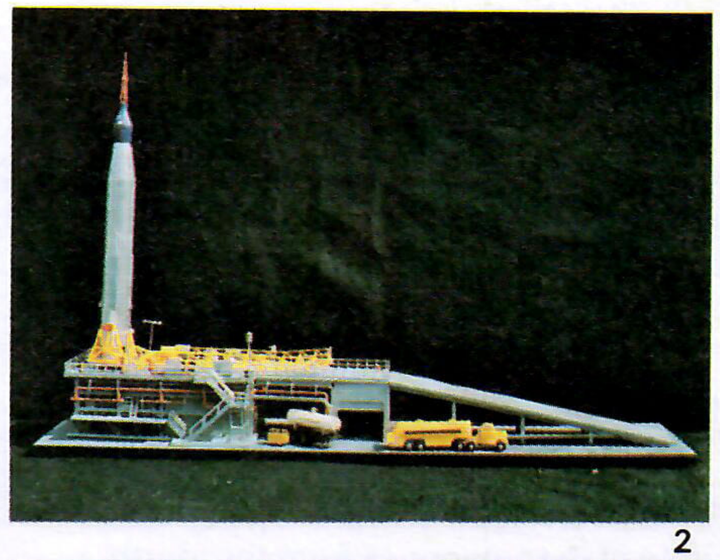

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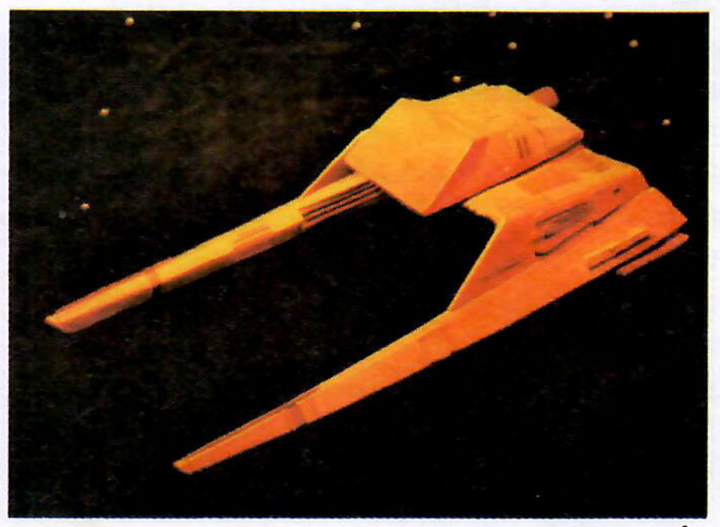

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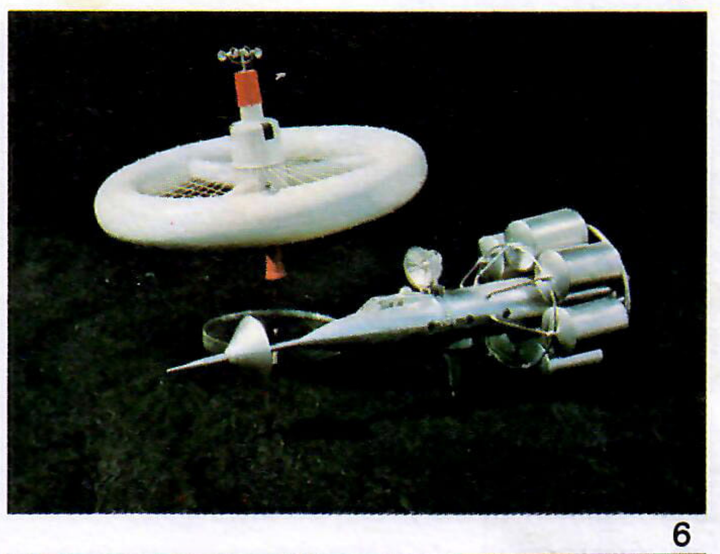

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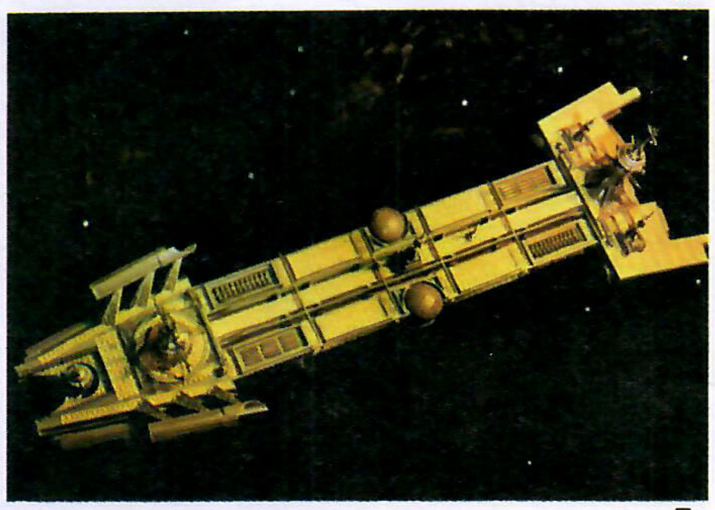

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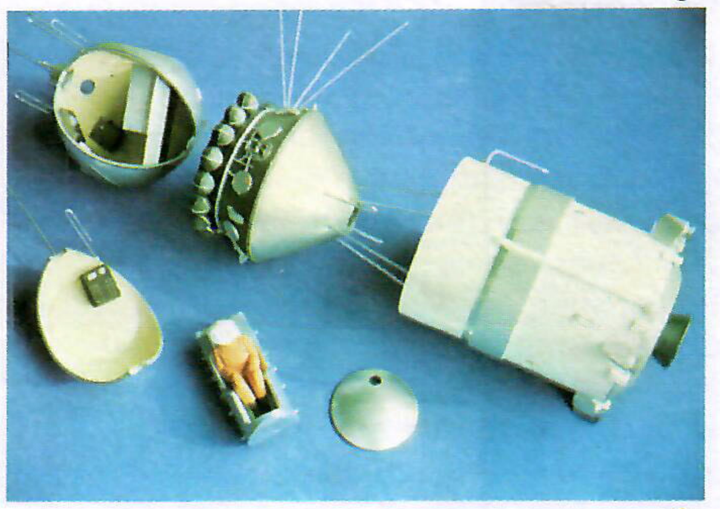

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1. ***Monogram's*** **Starfighter** ***and*** **Marauder** ***from 'Buck Rogers in the 25th Century' TV series.*** **2.** ***From earlier years, Revell's*** Mercury Atlas ***rocket with full back-up systems.*** **3.** ***Odd men out. Non-kit Kenner/Palitoy*** Landspeeders ***from 'Star Wars'. Model at left has been modified extensively – see Mat's feature elsewhere in this issue.*** **4.** ***Spock's*** Vulcan Shuttle, ***an AMT/"MATCHBOX" kit from 'Star Trek – The Motion Picture.'*** **5.** ***From Airfix, the free-styled*** Cosmic Clipper ***spaceship.*** **6.** ***Who remembers Strombecker from all those years ago? These are two prime examples; the*** Space Wheel ***and*** RM-1. **7.** ***MPC's*** Cygnus, ***'the mile-long Spaceship', from Walt Disney's 'The Black Hole'.*** **8.** ***VEB produce this finely-detailed model of the Russian*** Vostok. **9.** ***The*** Klingon battlecruiser from 'STTMP' – the updated version from AMT/ "MATCHBOX".

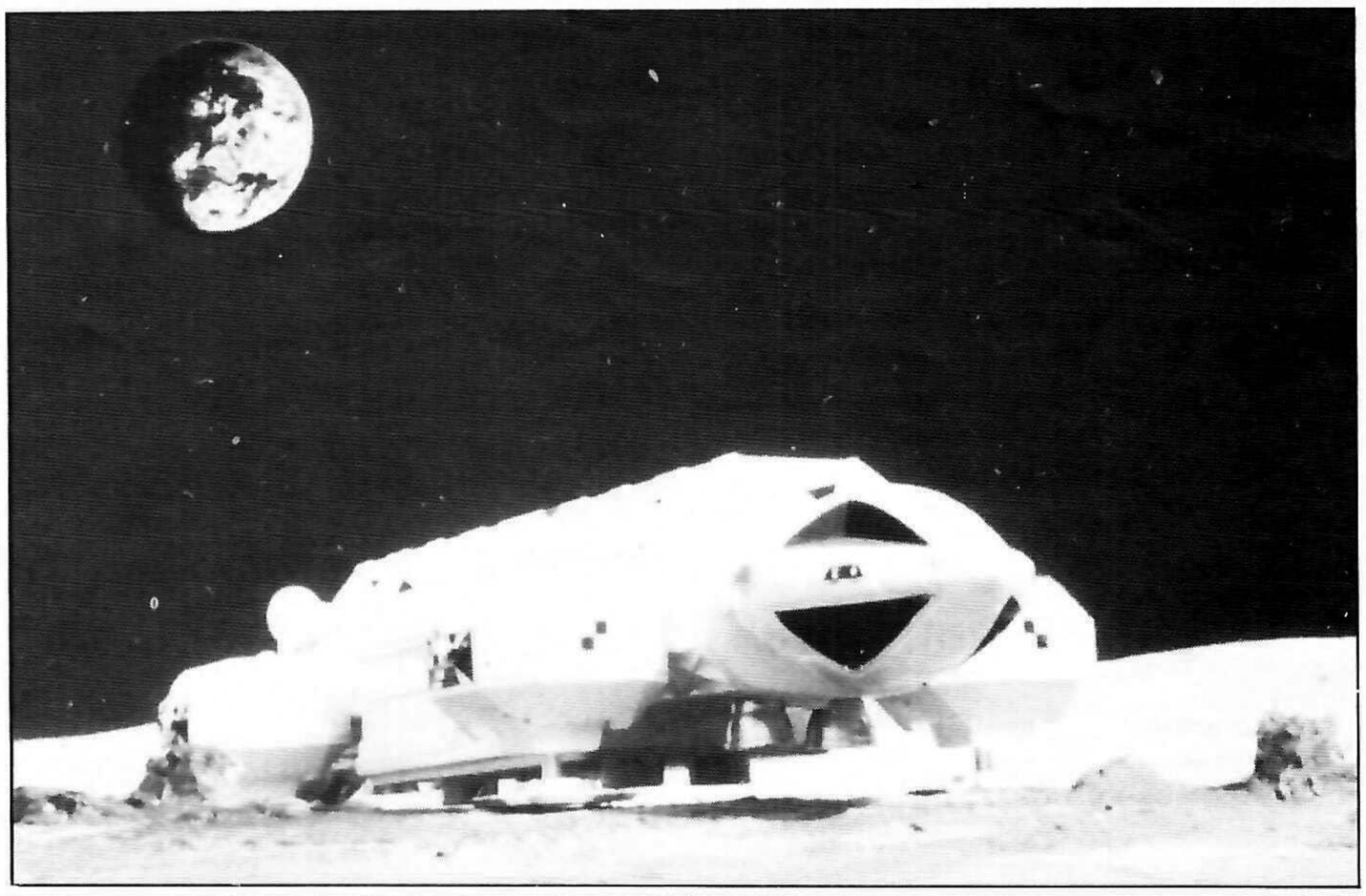
pointed out that it was extremely difficult to find *accurate* information in regard to the myriad of Japanese kits that flooded the market in Japan, but nowhere else. Andy and myself have obtained many of these kits, most thanks to Ken Sonokawa in Japan, but it doesn't help when you can't read the instructions. Consequently, although we know that so many *Space Cruiser Yamato* kits are available, we don't know which are which!

To keep this latest list from taking over SPACE VOYAGER completely, I've omitted some of the categories from the fourth edition. There I included diecasts, which in themselves now form a considerable list and will have to wait for a future date, and in addition the odd wooden kit that appeared. Not included, but which could also form a basis for a future piece, are the many flying rocket kits from **Estes, Cox** and **Centuri,** many of which are very accurate representations of the originals, considering they have been modified to fly. Other categories could also include limited-edition vacform kits and white-metal (gaming) craft.

Some of the inclusions in this list are border-line and I've used editorial perogative! For example, in many cases of Japanese kits, they are no more than snap-together toys. The ones included should fall into the other category of being more kit than toy, but I cannot be certain. In one of the other sections, the Futuristic Vehicles, possible only one – **AMT**'s *AMTronic,* should really be listed. However the others chosen, although existing as real cars, are examples of forward thinking and did stand out from a 'standard' (if such a term can be used) custom car, hence their inclusion.

In the Rocket section, only reseach rockets, as distinct from military missiles, are listed, with the exception of the V-2 which was widely used as a research rocket after the war by both the Soviets and the Americans. I have also left in the list two kits which were in fact never issued. They were the subjects of catalogue sheets, but unfortunately never saw the light of day in more solid form.

The details that follow are not as complete as Andy and myself would wish. Many of the kits have an interesting background but, again, if we started along that line the article would expand into a complete book. Perhaps *that* is the answer!



Top, the MPC Eagle from 'Space 1999'. Second row, left, Airfix Starcruiser Interceptor (large scale) and right, the original Starship Enterprise and Klingon battlecruiser from AMT. Third row, left, VINcent from 'The Black Hole' – an MPC kit – and right, MPC's Pilgrim Observer. Right, Apollo/Soyuz link-up kits. These are Addar (left) and Revell. The 1/25th scale versions behind are scratchbuilt.

MODEL LIST

Section	Kit name	Make	Scale	Details	Year
AIRCRAFT					
Seaking	SH3D Seaking	Airfix	1:72	No. 66, with astronaut and winch	1971
	SH3D Seaking	MPC	1:72	Airfix re-issue, Apollo patch	1971
				Re-issued without no. 66	1974
	SSH3A/D Seaking	Tamiya	1:100	No. 66	
X-20 Dyna Soar	Boeing X-20 Dyna Soar.	KR Models	1:72	Vacform	1981
X-15	X-15	Heller	1:130	NASA markings, engine detail	
	X-15	Starplast	1:130	Heller re-issue	
	B.52 with X.15	Revell	1:180	B.52 bomber and underwing X.15	1961
	North American X.15	Revell	1:65	NASA markings in later models	1959
	X.15	Miyauchi	1:70	No details known	
	X-15 Rocket Plane	Aurora	1:48	Based on very early plans	1958
	X.15	Sankol	1:86	No details known	
	USA Experimental X-15	San	1:100	Re-issued by Eldon and UPC	
	X.15	Busch	1:170	USAF markings	
	X-15 and F.105	Lindberg	1:170	X-15, Busch re-issue	
	X.15	Frankmodel	1:72	Vacform, with B.52 conversion	1977
ROCKETS					
Aerobee-Hi	Aerobee-Hi	Revell	1:40	Research rocket, with transporter and figures	1958
A-Type	Russian *Vostok*	Airfix	1:144	With *Vostok, Soyuz* and *Sputnik 1*	1969
	Russian *Vostok* RD-107	MPC	1:100	With *Vostok* and *Sputnik 2,* flyable	1970
				Re-issued without flying parts	1975
Jupiter C	Jupiter C	Revell	1:96	With launch tower and Explorer 1	1959
	Jupiter C Explorer Satellite Launcher	Hawk	1:48	With launch pad	1958
	US Army Jupiter C Missile	Comet	1:95	Uses an Atlas launch pad	
Mercury Atlas	Everything is Go	Revell	1:110	With Friendship 7 capsule and launch complex. Capsule out of scale with rocket. Atlas length 1:118 scale, diameter 1:128	1962
Mercury Redstone	Redstone Missile with Mercury Capsule	Revell	1:108	Launch pad and Freedom 7 capsule	1961
Saturn 1B	Saturn 1B	Airfix	1:144	Detachable stages and Apollo	1970
Saturn 5	Apollo Saturn 5	Airfix	1:144	Detachable stages and Apollo	1969
	Apollo Saturn	Monogram	1:144	Detachable stages and Apollo	1968
	Apollo Saturn 5 Moon Rocket	Revell	1:96	Detachable stages and Apollo	1969
	Saturn 5 with Apollo Spacecraft	AMT	1:200	Man in Space version, released separately	1970
	Apollo Saturn 5	Countdown	1:360	Launch tower and crawler	1969
	Apollo Saturn 5	Command Series	1:470	Moulded in Polythene	1980
Thor-Able	Thor at White Sands	Adams	1:80	With launch pad	1958
	Douglas Thor	Revell	1:110	Thor and Thor-Able versions with launch tower	1959
	Lunar Probe	Aurora	1:72		1959
Titan	Titan IIIC	MPC	1:100	USAF markings, flying parts	1970
				Re-issued without flying parts	1975
Vanguard	Vanguard at Cape Canaveral	Adams	1:80	With launch pad	1958
	Vanguard	Snap/Athern	1:80	Re-issued Adams kit	
	Vanguard	UPC	1:80	Re-issued Adams kit	
	Vanguard	Geobra	1:48	With internal detail and satellite, length/diameter ratio wrong.	
	US Navy Vanguard	Renwal	1:48	Re-issued Geobra kit.	
	Vanguard	Palmer	1:48	Re-issued Geobra kit.	
V-2	V1 and V2 Missiles	Faller	1:100	V2 with transporter	1968
	German Ballistic Missile V-2	Revell	1:69	With launch pad and transporter	1961
	V-2	Geobra	1:50	Re-issued – no details known	1972
	German Missile V-2	Eidai	1:76	With transporter, launch pad and trucks	1974
X-17	USAF Lockheed X-17	Revell	1:40	Research rocket, with launch pad and figures	1957
SETS					
Composite Kits	American Space Pioneers	Revell	1:48	Mercury and Gemini capsules, Apollo CSM and LES	1969
	Mercury and Gemini	Revell	1:48	Capsules. Very early kits had proposed Gemini skis version	1964
	Man in Space	AMT	1:200	Mercury Redstone and Atlas, Gemini Titan 2, Saturn 1B and 5	1969
	Adventure in Space	Revell	1:48	Apollo CSM, LM, LES and Adaptor	1970
			1:24	Gemini capsule	
			1:6	Gemini astronaut	
	Earth Satellites	Monogram	1:96	Jupiter C and Vanguard rockets	1958
	US Missiles	Monogram	1:128	Includes Jupiter C and Vanguard. Re-issued in sets MP.3 and 4	1958
	Thrills in Space	Monogram	various	Space Taxi, TV Orbiter, Orbital and Passenger rockets	
	Five Spaceships of the Future	Lindberg	various	Flying Saucer, Moonship, Space Station and Launchers	
	Nuclear Power	Adams	various	Thor and Vanguard (and Savannah ship)	
	Explorers of Space	Aurora	1:35	Astronaut	
			1:440	Radio Telescope	
			1:200	Apollo CSM and LM	1975
	Cops and Robbers	Revell	1:96	Moonship re-issue	
			1:150	Space Shuttlecraft re-issue	1965
SHIPS/BOATS					
	USS *Wasp*	Revell	1:520	Gemini recovery vessel	1966
	Hornet plus 3	Revell	1:490	Apollo recovery vessel	1974
	Astronaut pick-up boat	Imai	1:16	Two Gemini astronauts and motorised life-raft	

continued on page 72

MAN OUT OF TIME

SHORT STORY BY
JOHN WADE

He felt a drizzle of fine rain across his eyelids. For a moment he lay perfectly still as the sensation was passed through to his numbed brain. Slowly at first, but with a growing sense of awareness, the brain received its message from the nerve ends in his eyelids, analysed it, translated it and began to send out commands. He opened his eyes.

The changing colours of a nearby neon sign fell across his face. Red, then blue, now red again. He winced and sat up. His head banged; his eyes blurred, tried to focus, blurred again and finally cleared. He climbed carefully to his feet and looked around him.

How did he get here? Where was he? For that matter, *who* was he?

The alley he had been lying in was dark, lit only by the changing colours of the sign. He shook his head between the palms of outstretched hands, searched his memory for some clue to what might have happened. He found a name. His own name. Kendrew Latigue. Even as his lips soundlessly formed the words, his mind associated the name with other words. They came back to him now, as strong as they were meaningless:

"Kendrew Latigue, the best time-driver in 500 centuries."

His head was beginning to clear now. The ceaseless pounding died to a dull roar as he made his way out of the alley and into a street. Silence wrapped itself around him like a blanket. Silence, he realized, was something he wasn't used to. Streets, towns, cities; they were all continuously noisy where he came from.

A sound now. The soft tinkling of a piano. It came from a building at the end of the street. Latigue made his way towards the sound and looked through the misted windows of a drab little bar. Inside, the barman was polishing glasses. The place was empty apart from the pianist in the corner.

This was a drinking house. He was sure of it. He had seen pictures in . . . in . . . where? He couldn't remember. What he could remember was that the drink sold in places such as this fortified, revived. Latigue pushed open the door and went in.

The barman stopped his polishing and surveyed his customer with idle curiosity. "Yes sir?" Latigue pointed to a bottle and the barman filled a glass from it. Latigue took the glass, emptied its contents in a single gulp and indicated that he'd like another. With the second one he took more care, sipping it slowly, letting the liquid burn its way down his throat and into his stomach. Gradually, fragments of memory seeped into his brain and he realized there was something he had to know. For the first time, he felt strong enough to speak.

"When am I?" he asked.

The barman took him for a foreigner. "No sir. You mean: 'Where am I?' "

Latigue controlled a sudden feeling of irrational fear. "No. I mean: '*when* am I?" What is the date?"

"Oh I see," the barman said, smiling now. "That's easy. It's the 26th."

"Of what?"

"August."

Latigue's growing desperation got the better of him. He curled his fist into a ball and slammed it down on the bar counter. "What century?" he demanded.

"Sir?"

"The century, damn you! What century is this?"

"Well, the 20th, of course. What else . . . Hey!" This last word came as Latigue turned and prepared to leave. "You owe me for those drinks."

Latigue turned. "Owe?"

"Yes. Owe. Money. You understand?"

"Money?" Latigue whispered. "I have no . . . money."

The barman's eyes widened with a mixture of disbelief and anger. "Then I might have to call the police!"

Something in his tone annoyed and frightened Latigue. "No, please. Surely there's some service I can do for you in return for your hospitality?"

"There's only one service you can do for me," the barman said.

"Name it."

"Get the hell out of my bar!" And, lifting the flap in the counter, the man came at Latigue, clipped his arms neatly behind his back and threw him bodily into the street. He landed on the pavement with a thud that shook every nerve in his body. It also brought a sudden new flash of memory into his confused mind . . .

"Good morning ladies and gentlemen. Welcome to Time-Line. This morning's tour will take us briefly Down-Time to the 25th. Century, then back through our own 34th. and Up-Time to the 100th. with stops at the 50th., the 61st. and the 78th. I must remind you that

> *". . . The length of the journey is relative to three different factors",* she explained. *"We shall be travelling, in all, from the 25th to the 100th. In that respect, our journey will take 7500 years . . ."*

Time-Line is for pleasure purposes only and that as tourists you may only observe. Make no attempt to leave the timeliner or you may interfere with the delicate balance of Time."

Latigue watched the stewardess. He admired her grace and poise, the way she managed to go through the same speech over and over without ever making it sound as though she might be bored by the repetition.

As she spoke, she walked down the gangway between the seats. She reached the end, turned and walked back towards Latigue, sitting in the driving seat. Her eyes fixed themselves on him as she told the passengers: "Your time-driver for this morning is Kendrew Latigue." She smiled at him and he knew that she loved him. "Now, if there are any questions before we start?"

"Please, miss?"

She turned to the questioner with a professional smile. "Yes?"

"How long will the journey take?"

"The length of the journey is relative to three different factors," she explained. "We shall be travelling, in all, from the 25th. to the 100th. In that respect, our journey will take 7500 years." She paused for the several gasps of awe that always followed such a statement. "However, within the concept of the timeliner, the tour will take only the space of a morning – four hours to be precise, which is the amount we shall all age during the course of the journey." Again she paused before producing her trump card. "Nonetheless, time-driver Latigue will return us to the 34th. at a point no more than half a minute after we left. So, to the world outside, we shall have been away no more than 30 seconds."

She smiled as she completed her walk along the gangway and took her place in the seat next to Latigue. "And now, ladies and gentlemen, I leave you in the safe hands of Kendrew Latigue, the best time-driver in 500 centuries."

She turned to him with a smile as he pushed the time-lever into Down-Time, heading for the 25th. Century . . .

Latigue picked himself up from the pavement and began walking away from the bar. He thought again of the timeliner stewardess and remembered her name. Kristy Latigue. She was his wife: the girl he had met on a time trip and with whom he had taken no time at all to fall in love.

He shook his head as his mind reeled over this new anomaly. No, it was wrong to think of Kristy as having been his wife. She wouldn't be his wife yet for another 1400 years – give or take a few. Which brought him straight back to his original problem. How had he managed to get himself into the 20th. Century?

The Down-Time terminus was situated in the 23rd. It was impossible for anyone to travel further than that. Yet there he was. Slap, bang in the middle of the 20th. and, with time travel itself not being invented for another 300 years, he had, as far as he could see, no way of getting back to his home and wife in the 34th.

The 34th. Century. He thought of it now as he walked the dark streets of the 20th. Noise and bustle, everyone eager to be somewhere else. The whole country covered by a sprawl of ugly buildings. No greenery, no open spaces. It was not a good century to live in. Many times he and Kristy had thought (would think) about applying for permission to emigrate Down-Time, but the computations involved in establishing an up-timer in a different century made permanent Movement a possibility only for the very privileged or the very rich.

Latigue smiled as he remembered explaining the problem to a passenger named Finn on one of his trips a few weeks before, (several hundred years in the future). Finn had wanted to know why he couldn't leave the timeliner in the 27th. and have a look round . . .

"Look," said Latigue. "Let's say you went out into the 27th. and met, for instance, a young man who was destined to grow up to be the grandfather of a prime minister a century hence." Finn nodded. "Now supposing, by sheer accident, you killed that man. Or perhaps only injured him or said something that turned him against marrying the girl he was engaged to. Just by that act, you could stop the future prime minister being born. And since that future prime minister is, in effect, a part of your past, you can begin to see the complications that might arise.

"Which is why we can't have passengers wandering about Time. They could change history with nothing more than a snap of the fingers."

"I see," said Finn. "And that's why Time-Line is for observers only."

"Yes," Latigue told him. "Very, very few people have ever been allowed to leave a timeliner and fewer still have been allowed to settle in a century other than their own."

"So how did all this start?" Finn asked.

"How did time travel come into being?"

"Time travel was invented in the 23rd. Century by a scientist named Professor Heinlopf."

"He must have been a very clever man."

"On the contrary," Latigue went on. "He was no more than a very good scientist. But one night, history tells us, a stranger arrived at his front door, a man with a sheaf of hand-written papers. He handed them to the professor, told him to study them, and then left without even introducing himself. Later, when the professor saw what the papers contained, he tried to trace the mysterious stranger, but never found him."

"What did the papers contain?" Finn asked.

"The elementary maths of time travel," said Latigue. "With their help, the professor eventually built the first timeliner."

"But I still don't understand how a timeliner runs through Time," Finn said.

"Frankly," said Latigue, "neither do I. The theory is for the boffins. I'm a mere driver. But this much I do know. The timeliner runs on tracks in much the same way the old railway locomotives did. The tracks wind their way through Time on carefully computed co-ordinates that don't interfere with the actual moments they are passing through.

"There is an Up-Time terminus somewhere in the ten thousand millions when man has long since left the earth and the Sun is no more than a burnt cinder, and a Down-Time terminus in the 23rd. when time travel was invented."

"And there are no timelines either side of those termini?"

"That's right."

"Which is why we can't travel past the 23rd. when we go Down-Time."

"You've got it."

Finn thought for a moment and then he said: "I'd sure like to see that time when the Sun is no more than a burnt cinder."

"Time-Line run a special excursion once a month," Latigue told him. "But book early. Everyone likes to be in at the death."

He walked back to his driving seat, leaving one very awed passenger sitting behind him . . .

Dawn was creeping across the sky as Latigue left the city. He kept walking and, as the sun rose, he soon found himself surrounded by fields. He had never seen such emptiness in all his life. It scared him almost as much as it thrilled him. What a century to live in. If only Kristy could have been here to share it with him. He walked on, suddenly saddened by the thought of never seeing her again.

Mid-morning found him sitting on a farm gate, looking out over a view that took in fields and trees, rolling hills and the far off smudge of distant mountains.

The 20th. Century, he thought, was very much to his liking. But how, he asked himself over and over again, had he got here? He put his head in his hands, massaging his temples with his fingers. Think, man, think. How? Why? When?

And suddenly it came back to him. In a blinding flash, he saw it all. The how, the why and the when. His mind rocked as he was suddenly forced to relive that last terrifying journey through Time . . .

It had started as a purely routine run. One of the timeliners had developed a fault and become stuck in the 45th. Century. Engineers were sent Up-Time to sort out the bother, but not before the timeliner concerned had been forced to spend two days in limbo.

When they returned, the passengers were haggard, to say the least; the men, bearded and exhausted, the women sweaty and in filthy tempers, children crying, the whole party starving, having been without food for two days.

When they staggered out at the 34th. Century station, they had only been away 30 seconds.

The faulty timeliner was taken in for a thorough service. The fault was sorted out and, a few days later, Latigue was asked to take it on a test run. He climbed into the driving seat and pressed the time-lever into Up-Time. The machine slid along the time-lines smoothly and without a hitch.

He took it up as far as the 435th. Century, then stopped and began the journey back to the 34th.

It was as he passed the 50th. that things started going wrong. He began applying the brakes for a gradual slowdown into the 34th. but, to his surprise, nothing happened. He put extra pressure on the brake lever. For a moment, it remained stiff, then suddenly gave way. The brakes had failed. He had no way of stopping the thing. A rising sense of panic gripping at his throat, he checked the time-gauge. He was in the 39th. already – no, the 38th.

> "... He had to get off. What would happen if he just opened the door and jumped out? What did it matter? He was a doomed man anyway ..."

He gripped the time-lever, forcing it round into Up-Time. He checked the gauge again. 37th., 36th., 35th. He hurtled through the 34th. and on towards the finality of the 23rd.

He gripped his seat as he suddenly saw the inevitability of crashing into the Down-Time terminus. What would happen? Would it bring the timeliner to a stop? Would it kill him? He had no way of knowing. No-one had ever done it before.

Now he was in the 28th. Now the 27th.

Latigue rolled himself into a tight ball and hugged the seat. Any minute now. 25th., 24th., 23rd . . .

The expected crash never came. Instead, there was nothing more than a slight jarring of his mind. He sat up and looked again at the gauge. He was in the 22nd! But how was that possible? His mind raced almost as fast as the speeding timeliner and, yes, he saw now just how possible it all was.

Consider the timeliner to be like an old locomotive running on rails. Now, what happens if that locomotive crashes into the buffers at the far end of a line? Does it stop? Of course not. It keeps travelling. It doesn't need rails to make it go, only to keep it on the right course. And without those rails . . .

Latigue suddenly saw the whole thing in its frightening reality. The timeliner was still travelling Down-Time. It would keep travelling like this straight through history, down past prehistoric times to a time when man was no more than an animal, and further still to when there was no man at all, then no world, no universe.

He had to get off. What would happen if he just opened the door and jumped out? What did it matter? He was a doomed man anyway. Better to die leaping from the timeliner than to end up so far Down-Time that there was no world to jump into.

The last thing he saw was the gauge, telling him that he had just entered the 20th. Century. He opened the door and leapt for his life. It was black outside. The blackness opened up and swallowed him whole as the timeliner continued its journey down the interminable centuries . . .

So he was trapped in the 20th. Century with no way out. No way back. No way he would ever see Kristy again. For a while, he sat on the farm gate and wept.

During the following year, Kendrew Latigue slowly came to terms with his new life. He started by considering the very real possibility of suicide. It seemed a waste. To survive the leap from the timeliner only to kill oneself? Having come through that, he set about settling down to his lonely life in the 20th. Century. He was still a young man, only 26. He wasn't too old to learn a trade and make the best of his life here. Even if that life could never be truly fulfilled without Kristy.

He first took a job on a farm, digging ditches and the like. He learnt a lot from the farmer and he earned enough, after five years, to buy himself a small plot of land. There, he built a wooden cabin to live in. He visited libraries, he read a lot and the more he read, the more he learned. In a short while, he became completely self-sufficient.

At the beginning of his sixth year in the 20th. Century, he received two visitors.

It was an evening towards the end of Winter. The day had had the taste of Spring about it and Latigue had spent a few hours after his evening meal, sitting in front of his cabin and taking the air. As dusk had fallen, it had turned colder and now he was inside, building up a log fire that crackled and spat in the cabin's small fireplace.

Latigue smiled a comfortable smile and sat back in his favourite rocking chair with a book. Through the Winter he had been thinking about expanding his smallholding, getting some cattle, cows maybe, to make his own milk, butter and cheese. The book he held in his hands was going to tell him how. He had completed only three pages when there came a soft knock at his cabin door.

Latigue cursed. He had few visitors and liked it that way. He put the book down and went to the door. He opened it. And there stood Kristy.

He had no words to say and she had to speak for him. "Hello Kendrew." Two words. Simple and to the point, but enough to bring a rush of emotion to his bewildered senses. He took her in his arms and drew her close.

"Kristy," he murmured. "Is it really you?"

"Yes."

"But how? How did you get here?"

"I brought her."

This was another voice, a man's this time. Latigue looked up and a figure stepped out of the shadows behind his wife. The man was old, his hair was white and his face lined, yet he

held himself with the sureness of a man half his age. Latigue looked at the man and felt that perhaps he knew him. There was a familiarity about his features that he couldn't place. Was he someone from the 34th. whom Latigue had met (will meet) years before (years hence)? He couldn't remember and frankly he didn't care. All he cared about was the woman before him. Kristy. His wife. Back with him again.

"Well, come in, come in," he beamed.

The old man followed Kristy into the cabin and Latigue set about preparing them some food. Only when they had both eaten did he find the courage to ask the questions that had been exploding in his mind from the moment he had opened the door.

"Who are you?" he asked the old man. "And why are you here?"

"Who I am doesn't matter," came the reply. "As to why I am here . . ." He took a small folder of papers from his inside pocket and tossed them on to the table. Latigue picked them up and glanced briefly at the pages of figures and equations. In answer to his unasked question, the old man said: "It is the elementary maths of time travel. Study them and, with a little ingenuity, you should be able to build a mechanism that will take you back to your own time."

"But who are you?" Latigue asked the old man.

"That I cannot tell you," he answered.

Latigue looked at him and suddenly remembered the story of Professor Heinlopf and the mysterious stranger who had arrived at his front door one night and given him the secret of time travel. Was it possible that this was the same man? A man destined to travel Time, bringing its secrets to those who needed it?

The old man saw the realization in Latigue's eyes and nodded his head wisely. Then he rose to his feet. "And now, I am very tired," he said. "I am an old man. I'm sure you understand. If you have a bed . . ."

"Of course."

Latigue had only one bed, his own; but he led the old man willingly to it. To give him his bed for the night was the least he could do in the circumstances. So he left the old man in the bedroom and returned to the cabin's only other room and to Kristy, still sitting at the table.

He took her two hands in his and looked intently at her. "You look older, Kendrew," she said.

"I am older. It's been six years since I've seen you."

"And yet, I saw you only yesterday morning," she replied.

"Tell me about it," he said and then, holding tight to her hands, he listened quietly and without interruption while she told him the whole story:

"Yesterday morning – that is, yesterday in the 34th. – you were asked to take a newly repaired timeliner on a test run. You disappeared into Time and, apart from a brief flash through the 34th. a moment later, we never saw you again.

"Later, we heard that there had been some terrible damage done at the Down-Time terminus in the 23rd. Everything pointed to the fact that something had crashed straight through it. We put two and two together and came up with the fact that that 'something' must have been the timeliner you were on.

"They told me there was nothing they could do. You were lost in Time.

"That afternoon, in the midst of my despair, I had a visitor. The old man. When he first came to me, he seemed to think I ought to know him, but I didn't think I'd ever seen him before. He seemed strained somehow, lost, and so I invited him in.

"It was while I was giving him something to drink that a sudden sort of realization seemed to come over him. His eyes began to glow in a way I hadn't seen before and then he told me he could take me to you.

"I told him that was impossible because you were lost in Time and he said no you weren't. He knew exactly where you were and that I was to trust him and go with him.

"He seemed so sincere that I knew instinctively that I could trust him. He said that we should need to get aboard a timeliner alone and in secret. That was easy enough. I worked for Time-Line and no one questioned my presence when I stole him aboard just before a party of tourists was due.

"Immediately we were on board, he sat in the driving seat and pushed the time-lever into Down-Time. We raced for the 23rd, but, instead of stopping, we crashed straight through the terminus and just kept going. Then suddenly, with one eye on the time-gauge, he opened the door! I was petrified. But he just yelled out: 'Trust me' and then he grabbed me

"... Yesterday morning – you were asked to take a newly repaired timeliner on a test run. You disappeared into Time and apart from a brief flash through the 34th – we never saw you again..."

and bundled me out into nothingness.

"I think I must have passed out. When I came to, I was in a city miles from here. We walked and walked and, at last, we found your cabin. I thought it was chance but, now that I think about it, I'm sure he knew exactly where he was bringing me.

"He sent me up to knock on the cabin door while he hung back a bit. I knocked, you opened the door and you know the rest."

They talked on through the rest of the night and, as the early light of dawn crept across the sky, they finally fell asleep in each other's arms.

It was broad daylight when they woke and the cabin was completely silent. "I'll go wake the old man," Kristy said and went into the bedroom. A moment later, she appeared at the bedroom door, her face white. "Kendrew," she whispered. He looked up. "He's dead."

They buried the old man that afternoon on a hill overlooking the valley where the early blossoms of Spring were beginning to touch the trees with colour. As they walked, arm in arm, back to the cabin, Kristy looked at her husband and said: "It's a beautiful century isn't it?"

He nodded thoughtfully. "It's better than all the noise and bustle of the 34th, any day," he answered her.

They walked on in silence for a while. Then: "Do you remember, Kendrew," she asked, "the way we used to talk about how wonderful it would be to emigrate Down-Time?"

"I remember."

"Do you really want to return to the 34th?"

"No," he said. "Do you?"

She answered him with a kiss. Back in the cabin, they took the old man's folder of papers on time-travel and threw them into the bottom of a cupboard.

The time went past. Winter blossomed into a Spring that bloomed into Summer and mellowed into Autumn. Winter came again. Years went past, and Kristy and Latigue grew old together with a dual sense of contentment they each knew they could never have had in their own century. They farmed, they worked the land, they lived only for one another. For 20 years they lived and loved a life of complete happiness and then Kristy died.

She had been out one night with Latigue in the pouring rain when some of their animals had escaped. She had caught a cold, the cold had turned to pneumonia and, at last, she had died.

Latigue had never known such sorrow in all his life. It had been bad enough the first time he had lost her. But to lose her, find her, and then to lose her again was almost more than he could bear.

He buried her in a second grave, beside the old man's on the hill behind the cabin and, on Summer evenings, he took to climbing the hill and sitting with her as he looked out over the valley below. It was on one of these evenings that he suddenly realized how he could be with his wife again.

Item: Kristy was dead here in the 20th. Century.

Item: Kristy was alive in the 34th. up until the moment the old man arrived to take her away.

Therefore: If he, Latigue, could get to the 34th. and reach his wife just before the old man, they could be together again.

It made sense, didn't it? He thought it through once more, could see no problem and hurried back to the cabin to search his cupboards for that folder of maths on the elements of time travel.

It took him five long years to get to grips with the maths. He did so by copying every single page by hand and, as he copied, so he learned. After that, it took him another four years to assemble the parts he needed and then it took him three years to actually build the time traveller. When he had finished, he had a corner of the cabin covered in the mechanism which he had built around his old rocking chair.

At last it was finished. That night, he retired early, had a good night's sleep and, on waking, had an extra large breakfast. Then he went up the hill one last time to see Kristy's grave and to bid farewell to the century they had both loved so dearly. He returned to the cabin with very mixed feelings and, pausing only to pick up the folder of maths in case of emergencies, he sat down in the old rocking chair and strapped himself in before he had time to have second thoughts about the journey ahead of him.

He set the time-gauge for an automatic stop in the 34th., checked the power-gauge, sat back and pushed the machine into Up-Time.

The chair rattled and banged its way through Time, not at all like the slick and silent movement of a timeliner. Latigue could see the power-gauge visibly falling the farther he went

He prayed he had enough power to reach the 34th., but he needn't have worried. When he eventually came to a clattering standstill, the gauge still registered nearly half full.

He unstrapped himself from the chair and looked about him. Luckily, he was alone. The chair had landed in the cellar of what was obviously a deserted building. He left it where it was and made his way into the street.

He was in a part of the city he didn't recognize. The place looked familiar and yet in an alien sort of way. He walked to the end of the road, hoping to pick up some landmark he might know. Everything looked wrong somehow.

He walked on and soon came into a more crowded part of the city. This was more like the old 34th. that he knew and hated. Crowds, noise, bustle. He had no idea where his home might be but perhaps, he thought, he could get a bearing from the Time-Line station. He stopped a man who was about to stride right past him and asked directions.

The man looked blank. "Where?" he asked.

"The Time-Line station."

"Never heard of it."

The man began to walk away. Latigue ran after him, grabbed him by the arm. "What do you mean 'never heard of it'?" he demanded. "I want the Time-Line station."

"What are you talking about?" the man asked.

"Time-Line. You know. Time travel for tourists."

The man actually began to laugh. "Time travel?" he exploded. "What are you, some sort of nut? There's no such thing as time travel."

Again he turned away. Again Latigue pulled him back. "Wait a minute," he said. "What century is this?"

"Now I *know* you're a nut," the man laughed.

"Answer me," Latigue cried desperately. "What century is this?"

"The 34th. of course," said the man and, shaking himself free from Latigue's grip, he strode away to be swallowed up by the crowds.

Latigue leaned heavily against a wall. What was happening? He was in the 34th. and yet there was no time travel. Had he strayed, perhaps, into some other dimension of the 34th., into an alternate universe where time travel had not been invented? No, that was impossible. Then what was the explanation?

Without time travel, there could be no Time-Line. Without Time-Line, there would be no jobs for Kristy and himself. And without those jobs, he and Kristy could never have met. Could never have married.

There had to be time travel!

A slow glimmer of realization began to splutter and burn in his mind. If there was no time travel, it was because Professor Heinlopf had never received his visitor back in the 23rd. Latigue gripped the folder of maths in his inside pocket and knew suddenly what he had to do.

He made his way back to the cellar where he had left his time traveller. He checked the power-gauge. Half full. Just enough to get him to the 23rd. and back. He strapped himself in and shifted the machine into Down-Time.

He arrived back in the 23rd. in the middle of a deserted park. He took out the folder of maths and, separating his own hand-written copies from the originals, he set out to find the professor's house. It was night before he finally traced it. He knocked on the door and, when the professor opened it, Latigue thrust the sheaf of papers into his hands. "Study these," he said and, turning, he strode away again without even introducing himself.

Back in the darkness of the park, he strapped himself into his time traveller once more and headed Up-Time to the 34th. He arrived back in the cellar. He checked the time-gauge: afternoon on the day he had disappeared into Time. Now the power gauge: Drained. If things weren't right this time, he'd be trapped again.

He went out into the street and found, to his joy, that it was recognizable now and, yes, there across the street was the Time-Line station.

With a renewed bounce in his step, he made his way to the house where he and Kristy lived. His heart was beating like a crazy schoolboy's as he walked up to the door and knocked. There was silence for a few moments and then the door opened. Kristy stood there, red-eyed from crying, but still more beautiful than he had ever dared to remember her.

"Kristy," he breathed.

She wiped at her eyes. "Yes?" He took a step forward, but she barred his way. "Do I know you?" she asked.

"Do you . . . But you're . . . I mean, I'm . . ." She gazed at him with sad, unknowing eyes.

"Are you not well?" she asked. He stood silently staring at her. "Perhaps you'd better come in."

> "**. . . Without Time-Line, there would be no jobs for Kristy and himself. And without those jobs, he and Kristy could never have met. Could never have married. *There had to be time travel! . . .***"

He followed her into the familiar surroundings of their home. "You must excuse me," she said softly. "I've had some rather bad news today. My husband . . ."

"Has been lost in time," he murmured.

"You know?"

"Yes I know." He looked across at her but, instead of seeing her, he caught sight of his own reflection in the mirror behind her head. White hair now and a lined face. Suddenly he knew what was wrong, the reason why she hadn't recognised him. Six years he had been in the 20th. Century before she had come to him, 20 years they had lived together, 12 more years he had been building the time traveller. He was 64 years old, while she was still no more than 20. To her, he was an old, old man. There was a gulf between them that could never be bridged.

He sat heavily down in a chair. "Look, perhaps you'd like something to drink," she suggested. "You look as though you have suffered some terrible shock."

He nodded and she went to the kitchen.

It was while they were each sipping at the drinks that Kendrew Latigue realized for the second time that day what he had to do. He felt a renewed burst of energy at the thought. "Listen," he said. "Supposing I told you that I know where your husband is. Supposing I said I could take you to him."

That's impossible," she said. "Kendrew is lost in Time."

"No he isn't. I know exactly where he is and I can take you there. You must come." .

Ordinarily, Kristy wouldn't have dreamt of going along with this strange old man. But there was something about him that was so sincere that she knew instinctively that she could trust him.

He told her that she had to get them both secretly aboard an empty timeliner and she said that was easy enough because she worked for Time-Line. Half-an-hour later, they were on board, Latigue was in the driving seat and the timeliner was slipping into Down-Time.

Steadfastly, he kept his hand on the time-lever as the centuries whisked past: 30th., 29th., 28th., 27th. "We're going too fast," Kristy told him. "There's a terminus in the 23rd."

"We're going past that," Latigue said grimly. "Hold on tight."

Kristy looked at him as though she might have realized suddenly that he was insane. But there was little she could do except hold on.

With no more than a slight jarring of the mind, they crashed through the Down-Time terminus and now Latigue had his eyes fixed on the time-gauge as he began to open the door of the timeliner.

"What are you doing?" Kristy cried. "You're mad."

"Trust me!" he yelled and, grabbing her by both arms, pushed her out into the blackness of speeding time.

They came to in a city. It was night. They walked the streets until dawn came and they found themselves in the countryside. They walked right through the rest of that day until dusk began to fall again. Kristy was in a daze but her companion seemed to know where he was going and so she tagged along.

Shortly before nightfall, they came to the cabin. He sent her to knock at the door. She did so and when it was opened from the inside, there stood her husband.

They went in and Latigue, the old man, watched Latigue, the young man, as he embraced his wife. Only when they had eaten, did Latigue hand over the folder of elementary time travel maths.

After that, they talked for a while and then Latigue the Elder said: "And now, I am very tired. I am an old man. I'm sure you understand. If you have a bed . . ."

Latigue the Younger led him to the only bedroom and, as he quietly closed the door and left the old man alone, Latigue the Elder sat on the corner of the bed, listening to the sound of Kristy's voice in the next room as she went through the explanation of how and why she was there.

The old man smiled to himself. It was the smile of a man who knew exactly the way things were. He knew now that the circle was complete and that Kristy had 20 happy years ahead of her with the other Latigue, just as he knew, with a sudden finality, that he would close his eyes that night and never see the morning.

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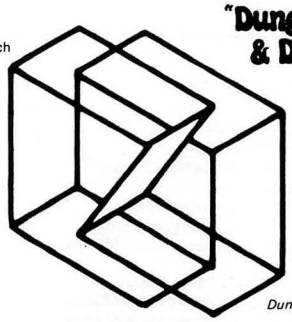

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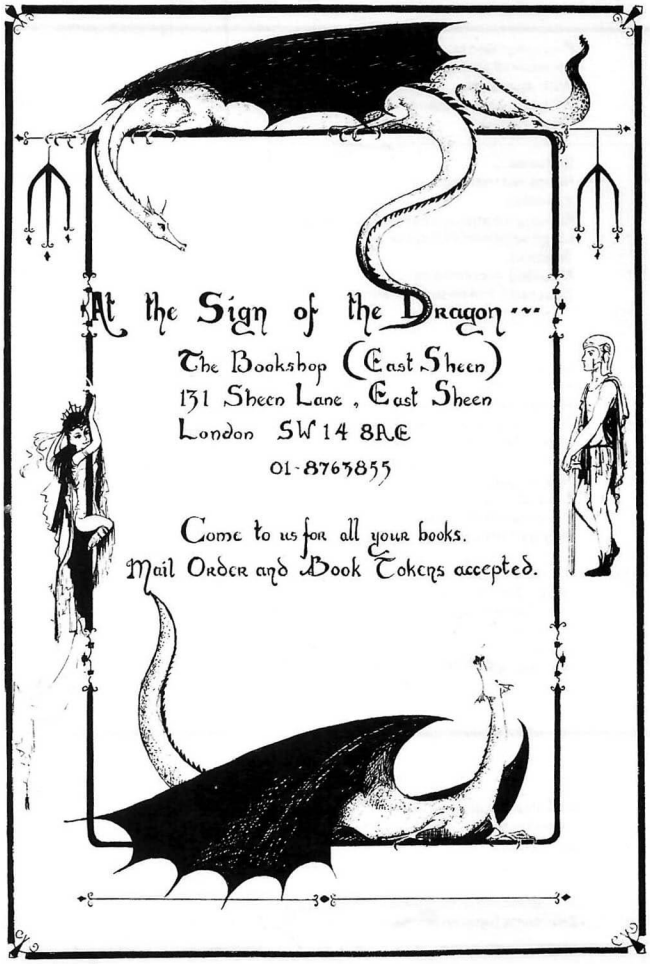
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(1) You have not received the goods or had your money returned; and

(2) You write to the Publisher of this publication, summarising the situation not earlier than 28 days from the day you sent your order and not later than two months from that day.

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

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This guarantee covers only advance payment sent in direct response to an advertisement in this magazine (not, for example, payment made in response to catalogues etc., received as a result of answering such advertisements). Classification advertisements are excluded.

MODEL LIST

continued from page 65

Section	Kit name	Make	Scale	Details	Year
SPACECRAFT					
Vostok	Russian *Vostok*	Revell	1:24	Cosmonaut, final rocket stage	1969
	Vostok 1	VEB	1:25	Capsule and final rocket stage available in UK	1977
Mercury	Mercury	Imai	1:28	No details known, matches Gemini	
Gemini	Gemini 7	Imai	1:28	Astronauts and lights	1969
	Gemini Capsule	Revell	1:24	Astronauts, opening hatches used in Adventure in Space	
Apollo	Lunar Module	Revell	1:48	LM with astronauts	1967
	Tranquillity Base	Revell	1:48	Re-issue of Lunar Module	1969
	Apollo Lunar Module	Monogram	1:48	With astronauts and experiments on base.	1970
				Re-issued	1979
	Lunar Module	Airfix	1:72	With astronauts and experiments	1970
	Apollo Lunar Module	Tamiya	1:70	LM issued separately from Apollo Spacecraft	1970
	Apollo Lunar Module	Marui	1:45	No details known	
	Apollo Lunar Spacecraft	Revell	1:48	LM, CSM, LES and Adaptor – CSM and LES used in American Space Pioneers. LM used in Lunar Module and Tranquility Base, all used in Adventure in Space	1967
	Apollo Spacecraft	Revell	1:96	CSM and LM, Moon base	1967
	Columbia and Eagle	Revell	1:96	Apollo 11, re-issue of above	1969
	Columbia and Eagle	AMT	1:200	Apollo 11, re-issue Man in Space	1970
	Snoopy and Charlie Brown	AMT	1:200	Apollo 10, re-issue Man in Space	1970
	Apollo Spacecraft	Tamiya	1:70	CSM, LM, LES and Adaptor (motorised)	1970
	Apollo Spacecraft	Marui	1:65	CSM, no details known	
	Apollo Command Module	Tamiya	1:70	Command and Service modules (motorised)	1970
	Apollo	Heller	1:96	CSM	1970
	Module Lunaire	Heller	1:96	LM	1970
	Programme Apollo	Heller	1:96	CSM and LM (issued by Aurora in USA)	1970
	Apollo Command Module	Monogram	1:32	Command and Service modules, with interior detail	1970
	Apollo Docking	Aoshima	1:96	CSM and LM (Apollo series no. 7)	
	Apollo series	Imai	v.	Includes LM, CSM and LM and Moon Globe	
Apollo-Soyuz	Apollo Soyuz US Soviet Space Link-Up	Revell	1:96	CSM and Soyuz and Docking Module ASTP badge stand	1975
	Rendezvous in Space	Addar	1:160	Super-Scene series	1975
LRV	NASA Lunar Roving Vehicle	AMT	1:25	Due for 1971 release, but never issued	
SPACE SHUTTLE					
Full Stack	Space Shuttle with Orbiter	Revell	1:144	Plus simplified launch pad	1978
	Columbia with Booster Rockets	Revell	1:144	Re-issue of above in *Columbia* markings	1981
	Space Shuttle	Airfix	1:144	With spacelab	1978
	Space Shuttle	Entex	1:144	With launch pad stand	1977
	Space Shuttle	G. Mark	1:144	Entex original	1977
Orbiters	Space Shuttle *Columbia*	Revell	1:72	Spacelab	1979
	Columbia Space Shuttle	Revell	1:72	Re-issued, new box	1981
	Space Shuttle Orbiter	Revell	1:144	Spacelab	1978
	Columbia and Spacelab	Revell	1:144	Re-issue of above, new box, *Columbia* markings	1981
	NASA Space Shuttle	Monogram	1:72	Large selection of Payloads	1979
	Space Shuttle Orbiter	Tamiya	1:100	Spacelab	1979
	Space Shuttle	Command Series	1:260	Moulded in polythene	1980
	Space Shuttle Orbiter 102 *Columbia*	Union	1:288	Spacelab, 2 manipulator arms	1981
	Space Shuttle *Columbia* and Rocket	Union	1:288		1981
	Enterprise Space Shuttle	Monogram	1:200	Snap	1978
ALT	Space Shuttle and Boeing 747	Revell	1:144	*Enterprise* and NASA 905	1977
	Columbia and 747	Revell	1:144	Re-issue of above, new box, Columbia markings	1981
	Space Shuttle and 747	Union	1:288	*Enterprise* and NASA 905	1978
SATELLITES	Explorer 1	ITC	1:6	Interior detail	
	Explorer 18	Hawk	1:20	Special balance stand	1968
	Vanguard Earth Satellite	Hawk	1:5	Clear panels, based on early engineering study	1958
	Mariner 2	Revell		Due for 1963 release, but never issued	
Astronauts	Astronauts	Airfix	1:76 (00/HO)	13 astronauts and equipment	1971
	American Astronaut	Aurora	1:12	With AMU, but out of scale	1967
	Gemini Astronaut	Revell	1:12	With Gemini capsule section	1968
	Gemini Astronaut	Revell	1:6	With Gemini capsule section	1967
	Apollo Astronaut on the Moon	Revell	1:7	Apollo 11 astronaut, with part of LM	1970
	Apollo Astronaut	Marui	1:6	No details known	
	Moon Survey	Eldon	1:10	2 astronauts, vehicle, 3D base	1966
SCIENCE FICTION (TV + CINEMA.):					
AP Films/Century 21/Group 3 TV					
Captain Scarlet	Angel Interceptor	Airfix	1:100		1968
		Imai		3 versions, including mini	
		Paramount		1 version (Imai re-issue?)	
	Astro 1	AMT	1:25	GM Design	1969
	SPV	Imai		2 versions	
		Paramount		1 version (Imai re-issue?)	
	MSV	Imai		3 versions, including mini	
		Paramount		2 versions (Imai re-issues?)	

Section	Kit name	Make	Scale	Details	Year
	Patrol Car	Imai		3 versions, including mini	
		Paramount		2 versions (Imai re-issues?)	
	Passenger Jet	Imai		2 versions	
		Paramount		1 version (Imai re-issue?)	
	Spectrum Helicopter	Imai		2 versions, including mini	
		Arii		Imai re-issue as N-216A	
	Cloudbase	Imai		1 version	
		Paramount		1 version (Imai re-issue?)	
	Secret Trailer	Imai		Truck and SPV	
		Paramount		(Imai re-issue?)	
	Col. White and Cloudbase	Imai		3" figure and small Cloudbase	
	Capt. Blue and Passenger Jet	Imai		3" figure and small craft	
	Capt. Grey & Helicopter	Imai		3" figure and small craft	
	Lt. Green and Mobile	Imai		3" figure and small vehicle	
Fireball XL-5	Fireball XL-5	Kitmaster		Lyons Maid offer	
Joe 90	Sam's Car	Imai			
		Tamiya		(Imai re-issue)	
	Mac's Car	Imai		2 versions	
		Tamiya		2 versions (Imai re-issues)	
Space 1999	Eagle	MPC/Airfix	1:72	Transporter version	1976
	Alpha Base	MPC		Vac-formed base, with larger scale Control Room	1976
	Eagle 1	Imai	1:96	Motorised	
Stingray	Stingray	Midori		2 versions – electri and elastic	
	Stingray	Paramount		2 versions – Midori re-issues	
	Stingray	Imai		Mini kit	
	Stingray	Airfix		Possible Midori/Paramount re-issue	
	Titan Terror Fish	Midori		Motorised	
	Stingray Set	Imai		Mini set, Stingray, Titan and Aquanaut	
Supercar	Attack 7 Sky Car	Aoshima		Modified Supercar	
Thunderbirds	Thunderbird 1	Imai		3 versions, 2 Island Base versions	
		Bandai		2 versions (Imai re-issues?)	
		Paramount		1 version (Imai re-issue?)	
		AHM		1 version (Imai re-issue?)	
	Thunderbird 2	Imai		4 versions, 2 Island Base versions	
		Bandai		2 versions (Imai re-issues?)	
		Paramount		1 version (Imai re-issue?)	
		AHM		1 version (Imai re-issue?)	
	Thunderbird 3	Imai		2 versions, 1 Island Base version	
		Bandai		2 versions (Imai re-issues?)	
		Paramount		1 version (Imai re-issue?)	
	Thunderbird 4	Imai		4 versions, 2 Island Base versions	
		Bandai		2 versions (Imai re-issues?)	
		Paramount		1 version (Imai re-issue?)	
	Thunderbird 5	Imai		1 version, 1 Island Base version	
		Bandai		1 version (Imai re-issue?)	
		Paramount		1 version (Imai re-issue?)	
		AHM		1 version, includes small TB3	
	Thunderbird 2 Pods	Imai		5 versions	
	FAB 1 Rolls Royce	Imai		1 version	
		Paramount		1 version (Imai re-issue?)	
	Mole	Imai		3 versions	
		Bandai		1 version (Imai re-issue?)	
	Zero X	Imai		2 versions	
	Thunderbird 6 and Skyship	Imai		1 version	
		Paramount		1 version (Imai re-issue?)	
	Excavator	Imai		2 versions	
	Firefly	Imai		2 versions	
	Recovery Vehicle	Imai		1 version	
	Tracy Island	Imai		2 versions, plus vehicles	
		Bandai		1 version (Imai re-issue?)	
	Scott Tracy and TB1	Imai		3" figure and small vehicle	
	Virgil Tracy and TB2	Imai		3" figure and small vehicle	
	John Tracy and TB5	Imai		3" figure and small vehicle	
	Gordon Tracy and TB4	Imai		3" figure and small vehicle	
UFO	Shadomobile	Imai		With small SkyShip	
	Sky 1	Imai			
	Interceptor	Bandai			
	UFO	Bandai			
	SID	Bandai			
	Skydiver	Bandai			
	Moonbase	Imai		With Interceptor, Shuttle, Sky 1	
	UFO Set 1	Imai		Shadomobile? Shuttle, Fan Aircraft	
	UFO Set 2	Imai		Interceptor, Capsule, Excavator	

US TV

Battlestar Galactica	*Viper* Space Fighter	Monogram	1:24		1978
	Raider Space Fighter	Monogram	1:48		1978
	Cylon Base Star	Monogram			1979
	Battlestar Galactica	Monogram			1979
Blue Noah	Blue Noah a/c carrier	Bandai	1:100	Japanese Cartoon – Minibox series	
	Blue Noah fighter a/c	Bandai	1:100	Japanese Cartoon – Minibox series	
	Submarine	Bandai	1:100	Japanese Cartoon – Minibox series	
Buck Rogers in the 25th Century	*Starfighter*	Monogram	1:48		1979
	Marauder	Monogram	1:48		1979

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Dick Tracy	Magnetic Space Coupe	Aurora	1:72	With base and 4 figures	1968
	Dick Tracy	Aurora	1:16	Fire-escape scene	1968
Galaxy Express	GE 999	Bandai	1:100	Japanese Cartoon – Minibox series	
	222	Bandai	1:100	Japanese Cartoon – Minibox series	
	777	Bandai	1:100	Japanese Cartoon – Minibox series	
	333 Cosmo Combat	Bandai	1:100	Japanese Cartoon – Minibox series	
	444 Galaxy	Bandai	1:100	Japanese Cartoon – Minibox series	
	555 Oruodia-5	Bandai	1:100	Japanese Cartoon – Minibox series	
The Invaders	UFO	Aurora	1:72	With removable top	1968
	Flying Saucer	Aurora	1:72	Re-issue, new base	1975
	UFO	Monogram	1:72	Re-issue	1979
Land of the Giants	Spaceship	Aurora	1:64	With interior and crew	1969
	Rocket Transport Spindrift	Aurora	1:64	Re-issued Spaceship	1975
	Snake	Aurora	1:48	Figures and giant snake	1968
Lost in Space	The Robot	Aurora	1:11	On rocky base	1968
	Lost in Space	Aurora	1:32	Robinson family, Cyclops	1967
	Lost in Space	Aurora	1:32	As above, including Space Chariot	1967
	Lost in Space – Jupiter 2	San		2 versions	
Six Million Dollar Man/Bionic Woman	Bionic Bustout	MPC/Denys Fisher	1:12	Dungeon scene	1975
	Fight for Survival	MPC/Denys Fisher	1:12	Gorilla scene	1975
	Evil Rider	MPC	1:12	Motorbike scene	1976
	Bike Bully	Denys Fisher	1:12	Re-issue of above	1976
	Jaws of Doom	MPC	1:12	Crocodile scene	1976
	Teeth of Terror	Denys Fisher	1:12	Re-issue of above	1976
	Bionic Repair	MPC	1:12	Jaime Sommers and Oscar Goldman	1977
Space Cruiser Yamato (Starblazers)		Bandai		5 versions of Yamato, 14 other craft 2 walking machines, 30 minibox series	
Star Trek	USS *Enterprise*	AMT/Aurora	1:635	Original versions had lights	1967
	Klingon Vessel	AMT/Aurora	1:635	AMT version originally had lights	1968
	Galileo 7	AMT	1:35	*Enterprise* shuttlecraft	1974
	Mr Spock	Aurora/AMT	1:12	On base, including 3 headed snake	
	Exploration Set	AMT	1:2	Phaser, Tricorder and Communicator	1974
	Romulan Bird of Prey	AMT	1:635	Romulan spaceship	1975
	Enterprise Bridge	AMT	1:32	Kirk, Spock and Sulu figures	1975
	USS *Enterprise*	Midori	?	No details known	
	K7 Space Station	AMT	1:7600	From Trouble with Tribbles	1976
	Star Trek Space Ships	AMT	1:2200	*Enterprise,* Romulan and Klingon	1976
	Battle Cruiser	Zocci	1:3800	Snap together games version	1976
	Scout Ship	Zocci	1:3800	Snap together games version	1976
	Destroyer	Zocci	1:3800	Snap together games version	1976
Voyage to the Bottom of the Sea	Seaview	Aurora	1:300	With sea-bed base	1966
				Re-issued with Sealab base	1975
	Seaview	Midori	1:325	With miniature Flying Sub, motorised	
	Flying Sub	Aurora	1:60	With interior and crew	1968
				Re-issued	1975
	Flying Sub	Monogram	1:60	Re-issued Aurora	1979

CINEMA

Alien	Alien ♂	MPC	1:12	Alien III	1980
The Black Hole	Cygnus	MPC	1:4225		1980
	Maximillian	MPC	1:12	With levitation stand	1980
	Vincent	MPC	1:12	With levitation stand	1980
The Final Countdown	The Final Countdown	Monogram	1:825/1:72	*Nimitz* and Tomcat re-issues	1980
Moonraker	Moonraker	Airfix	1:144	Full stack copy of NASA original, with new transfers	1979
	Moonraker Space Shuttle with Booster Rockets	Revell	1:144	Full stack copy of NASA original, with new transfers	1979
	Moonraker Space Shuttle	Revell	1:144	Orbiter only	1980
Planet of the Apes	Cornilius	Addar	1:12	With Exchange building base	1973
	Dr Zaius	Addar	1:12	With Library ruins base	1973
	General Ursas	Addar	1:12	With ruined house base	1973
	General Aldo	Addar	1:12	With stockade base	1973
	Dr Zira	Addar	1:12	With laboratory base	1974
	Ceaser	Addar	1:12	With treehouse base	1974
	Ape on Horseback	Addar	1:12	Soldier Ape	1975
	Cornfield Roundup	Addar	1:32	Super-Scenes	1975
	Galen's Tree House	Addar	1:32	Super-Scenes	1975
	Jail Wagon	Addar	1:55	Super-Scenes	1975
2001 A Space Odyssey	Moonbus	Aurora	1:55	With interior and figures	1969
	Pan Am Space Clipper 2001	Aurora	1:144	*Orion,* with engine detail	1968
	Space Shuttle *Orion*	Aurora	1:144	Re-issue of above	1975
	Orion Spacecraft	Airfix	1:144	Different version	1970
	Orion Space Clipper	San		Motorised	
Star Trek The Motion Picture	USS *Enterprise (Mk 2)*	AMT/Matchbox	1:500	With lights	1980
	Klingon Cruiser	AMT/Matchbox	1:635		1980
	Vulcan Shuttle	AMT/Matchbox			1980
	Mr Spock	AMT	1:12	(Modified from original version)	1980
Star Wars	Luke Skywalker's *X-Wing* Fighter	MPC	1:50	Movable wings	1978

Section	Kit name	Make	Scale	Details	Year
'A New Hope' and	Luke Skywalker's *X-Wing* Fighter	Revell/Takara	1:72	Motorised	1978
'The Empire Strikes Back'	Darth Vader's *TIE Fighter*	MPC	1:32	Vader figure	1978
	Millennium Falcon	MPC	1:72	Movable undercarriage	1980
	R2-D2	MPC	1:8	Movable legs	1978
	R2-D2	Revell/Takara	1:10		1980
	C-3PO	MPC	1:8	Movable arms/legs	1978
	Darth Vader	MPC	1:8	Movable arms/sabre	1980
	Darth Vader head	MPC	1:2	Rasping sound	1979
	Star Destroyer	MPC	1:1800		1981
	Luke Skywalker's *Snowspeeder*	MPC	1:35	Movable airbrakes/cockpit canopy	1981
	AT-AT	MPC	1:75	Movable legs/head	1981
	Battle on Ice Planet Hoth	MPC	1:150	Snaptogether – including 3 AT-ATs, 3 *Snowspeeders* and 50 figures	1981
	Encounter with Yoda on Dagobah	MPC	1:12	Luke, R2 and Yoda; snaptogether	1981
	Darth Vader Van	MPC	1:32	Snaptogether, based on same designs, not from films	1980
	Luke Skywalker Van	MPC	1:32	Snaptogether, based on same designs, not from films	1980
	R2-D2 Van	MPC	1:32	Snaptogether, based on same designs, not from films	1980
Superman	Superman	Aurora	1:9	Original comic character	1965
	Superboy	Aurora	1:9	Original comic character	1973
	Superman	Monogram	1:9	Planned re-issue of Aurora original	1978

MISCELLANEOUS

Other Science Fiction Models	Arcadia	Takara	1:1500	From Captain Harloc (Japanese cartoon)	1978
	The Voyager	Aurora	1:96	From Fantastic Voyage (cartoon version)	1969
	Martian War Machine	?	?	Limited edition, made to publicise film	1953
	The Creature	Aurora	1:8	From The Creature from the Black Lagoon	1963
	The Creature from the Black Lagoon	Aurora	1:12	New snaptogether version	1976
	Ghidrah	Aurora	1:600	Japanese film monster	1976
	Rodan	Aurora	1:600	Japanese film monster	1976
	Godzilla	Aurora	1:600	Japanese film monster	
	Godzilla	Monogram	1:600	Re-issued Aurora	1978
	King Kong	Aurora	1:25	From the film(s)	
	Rampaging Scorpion	MPC/Airfix	1:96	City centre scene	1976
	Colossal Mantis	MPC/Airfix	1:96	Railway scene	1976
	Gigantic Wasp	MPC	1:96	Amusement park scene	1976
	Huge Tarantula	MPC	1:96	Power station scene	1976
	Flash Gordon	Revell	1:8	Planetary scene, with Martian	1965
	Bigfoot	AMT	1:9	Snaptogether	1978
	Dragun	Monogram	1:10	Shogun warrior	1978
	Great Mazinga	Monogram	1:10	Shogun warrior	1978
	Raydeen	Monogram	1:10	Shogun warrior	1978
	Grandizer	Monogram	1:10	Shogun warrior	1978
	Gaiking	Monogram	1:10	Shogun warrior	1978
	Raider	Monogram	1:10	Shogun warrior	1978
Battle of the Planets	The Phoenix	Bandai/Entex		First Season	1979
	G1 SP	Bandai/Entex		First Season	1979
	G1	Bandai/Entex		Second Season	1979
	The Phoenix	Bandai/Entex		Second Season	1979
	Space Station	Eidai/Grip/Entex			1979
Message from Space	Galaxy Runner	Bandai/Entex			1979
	Liabe	Bandai/Entex		Japanese	1979
	Comet Fire	Bandai/Entex		cartoon-based	1979
	Star Wolf	Bandai/Entex			1979
Others	Discoverer	Imai	1:96	Rolling Moon vehicle	
	Magmaliser	San	1:96	Tracked under-ground vehicle	
	Ultra Hawk UH-001	San	1:144	Large SF Fighter/Bomber	
	The Amazing Moon Mixer	Revell	1:25	With Apollo CSM Mixer	1974
	The Alien	MPC	1:25	Modified Barris Moonscope	1977
	Leif Ericson	AMT	1:635	AMT's own series, with lights	1969
	UFO Mystery Ship	AMT	1:635	Re-issued, modified Leif Ericson	1974
	Flying Saucer	Lindberg	1:48	With green pilot	1952
	Impetus	Aurora	1:200	Design for atomic airliner	1959
	Ragnorac Orbital Bomber	Aurora	1:200	Reworked, re-issue of Impetus	1975
	Beta 1	Hawk		Atomic powered bomber	
	Time Machine	MPC	1:18	Strange Change series	1974
	Apollo 1	Tamiya	1:48	Tracked Moon vehicle	
	Jupiter 2	Tamiya	1:48	As Apollo 1, but with rockets	
	George Adamski – Type 1:X Flying Saucer		1:60		1978
Launchers	TV Orbiter	Monogram	1:96	W. Ley design, Landsat launcher	1959
	Passenger Rocket	Monogram	1:192	W. Ley design, early Shuttle type	1959
	Orbital Rocket	Monogram	1:192	3 stage version of above	1959
	TWA Moonliner	Strombecker	1:80	Original Disneyland rocket	1954
	Satellite Launcher	Strombecker	1:262	Disney series	1954
	Man in Space Ship	Strombecker	1:262	Same basis as above	1954
	Helios	Revell	1:160	K. Ehricke design for Moon lander	1959
	Solaris	Revell	1:160	Re-issue of Helios	1968
	Convair Space Shuttlecraft	Revell	1:150	K. Ehricke design for early shuttle concept	1959
	XSL-01	Revell	1:96	Systems Laboratories design	1958
	Saturn Interplanetary Space Vehicle	Hawk	1:87	3 or 4 stages, originally issued as Atlas ICBM	1966
	Satellite and Launcher	Lindberg	1:200	3 stage rocket	
	Mars Probe Communications Satellite	Lindberg	1:200	Re-issue of above	1971
	Three Stage Rocket	Lindberg	1:200	Manned version of above	
	Mars Probe Space Transport	Lindberg	1:200	Re-issue of above	1971
	Star Probe USS Explorer	Lindberg	1:200	Re-issue of above	1976
	Saturn 6	Bandai		Shuttle-type	

Section	Kit name	Make	Scale	Details	Year
Spacecraft	Space Taxi	Monogram	1:48	W. Ley design, with astronauts	1959
	Space Buggy	Monogram	1:48	Re-issue of above	1969
	RM1 Rocketship	Strombecker	1:72	W. V. Braun design, Disney series	1954
	Convair Manned Vehicle Nuclear Interplanetary	Strombecker	1:91	K. Ehricke design	1955
	Convair Manned Vehicle Lunar Reconnaissance	Strombecker	1:91	K. Ehricke design	1955
	Convair Manned Vehicle Observational Satellite	Strombecker	1:198	K. Ehricke design	1955
	Moonship	Revell	1:96	Re-issue of XSL-01 final stage	1959
	US Moonship	Lindberg	1:70	Moon lander design	
	Mars Probe Landing Module	Lindberg	1:70	Re-issue of above	1971
	Star Probe Space Shuttle	Lindberg	1:70	Re-issue of above	1976
	Pilgrim Observer	MPC	1:100	Space station/ship design	1970
	Starcruiser 1	Airfix	1:48	Snaptogether, 4 craft	1978
	Starcruiser Interceptor	Airfix	1:24	Snap. Larger version	1980
	Cosmic Clipper	Airfix	1:300	Snap. 3 craft	1981
	Space Prowler/Cosmic Starship	Airfix	?	Snap. Flying Saucer design	1982
Space Stations	Space Station	Revell	1:96	Systems Laboratories design, including Space Taxi, Spaceship, Maintenance and Research vehicles	1959
	Space Wheel	Strombecker	1:300	W. V. Braun design, Disney series	1954
	Convair Atlas Space Station	Hawk	1:98	K. Ehricke design, manned version of Atlas rocket	1958
	Manned Orbiting Laboratory	Hawk	1:98	Re-issue of above	1964
	Space Station	Lindberg	1:350	Wheel-type space station	
	Mars Probe Space Station	Lindberg	1:350	Re-issue of above	1971
	Star Probe Space Base	Lindberg	1:350	Re-issue of above	1976
Vehicles	Astro 1	AMT	1:25	GM design	1968
	AMTronic	AMT	1:25	Intercity-car with built-in town-car	1970
	Leva Car	AMT	1:18	Ford design	1960
	Pontiac Club de Mer	Revell	1:25	GM design	1958
	Ford Futura	Revell	1:25	Ford design	1958
	Futurista	Monogram	1:24	Darryl Starbird design	1965
	Predicta	Monogram	1:24	Darryl Starbird design	1965
	Dodge Deora	AMT	1:25	Alexander Brothers design	1968
	Vantasy	AMT	1:25	Re-issue of Deora	1977

Acknowledgements
Thanks to the following individuals who over the years have added to the details in this list – Martin Postranecky, Brian Sampson, Jack Fouché and Geoff Weir.

Publishers' note: Inclusion of any item in this list does not imply current availability of the product – most are now discontinued. Further, neither Mat Irvine, nor the publishers of Space VOYAGER can supply readers any kit mentioned in this survey nor do they know of any current sources for rare models. Updates and corrections are welcome–write to MAP, PO Box 35, Bridge Street, Hemel Hempstead, Herts, HP1 1EE.

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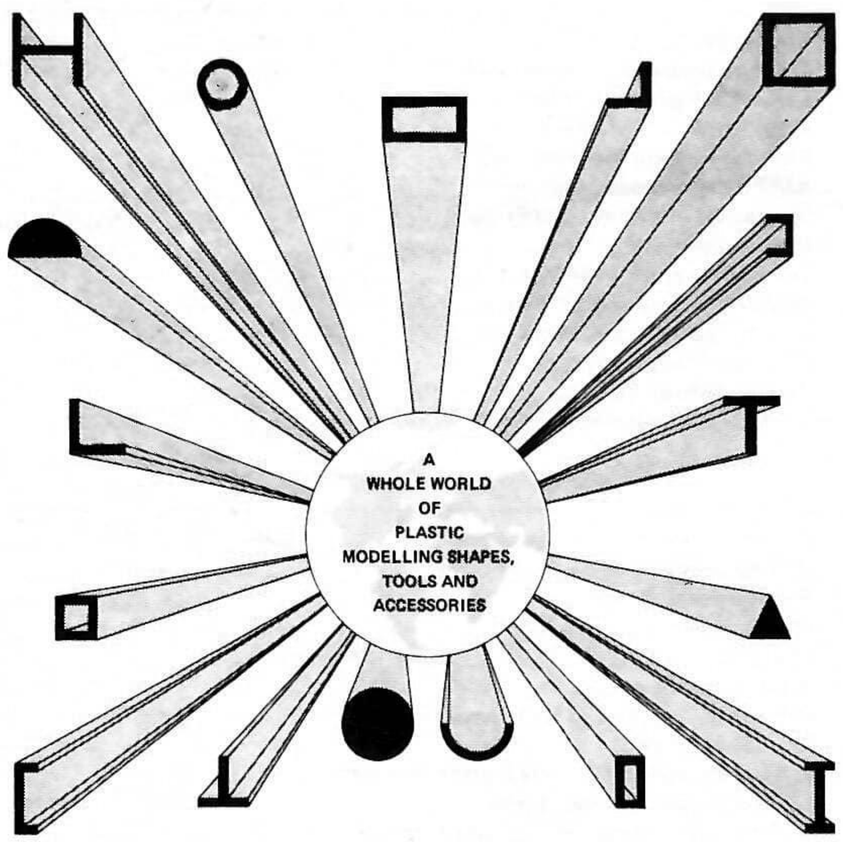

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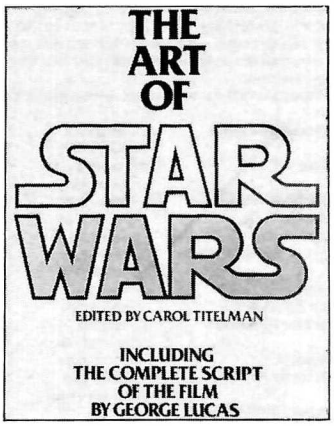
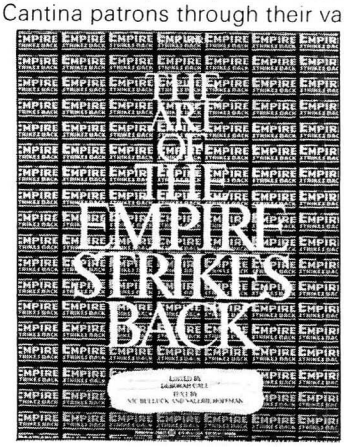


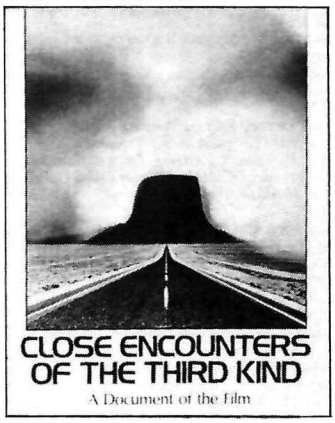
'The Art of Star Wars' and 'The Art of the Empire Strikes Back' edited by Carol Titelman and Deborah Call respectively. Published in the USA by Ballantine Books and available in the UK from specialist book shops at around £8.10 each. Soft covers.

Although neither of these impressive titles can be termed really new, they are such extraordinarily good value, both in monetary terms and as reference, that they warrant an appraisal here. First, Carol Titelman has provided followers of George Lucas's gradually unfolding 'Journal of the Whills' with a lavishly-illustrated and highly-readable record of *Star Wars* and the extent of production work which was required. There are over 170 glossy pages packed with stills (mostly colour) from the film, pre-production paintings, sketches and designs, all cleverly interpolated with the complete script of the film by Lucas. It is fascinating to watch the build-up of designs for R2D2, C3PO, Darth Vader and the Cantina patrons through their various



differing stages before becoming the popular figures now so familiar to us all. Towards the rear of the book a collection of film poster reproductions can be found giving a graphic indication of ad. design work and how it was used to promote the product in a myriad of different ways.

'Empire' is rather different in approach although no less impressive in stature. There is no script this time, in fact text matter is kept strictly minimal with the emphasis again on pre-production paintings with fewer movie stills. The sheer brilliance of artists like Ralph McQuarrie and Mike Pangrazio is never more evident than in this upmarket showcase of their's and others' undeniable talents. There are also a large number of scale drawings in this book which will be of value to modellers of *Snowspeeders* and *AT-AT Walkers* especially as the schematics are supported by colour photos of superb clarity. What text there is concentrates on the technical aspects of production: matt painting, animation, stop motion, evolution of *Yoda* and a great deal more. Both books offer a lasting record of two films that have quickly established themselves as landmarks in cinema history. We look forward to reviewing 'The Art of Revenge of the Jedi' in due course . . . **RLR**



'Close Encounters of the Third Kind. A Document of the Film' edited by Thomas Durwood. Published by Aeriel Books/Ballantine Books at $10.95 (US). Soft covers.

Although this magnificent book, similar to the *Star Wars* and *Empire* volumes described previously, first appeared in 1978 it now becomes topical with the first TV screening over Christmas. We wonder how many fans of Speilberg's controversial, but uplifting, film will have sat glued to their sets whilst forking away the turkey and mince pies, transfixed yet again by this powerhouse of a movie. Whether the creator of a menacing 'Rubber Duck' and an even more menacing fish was wise to re-release his third major enterprise with additional scenes and much editing, still arouses argument. But in either form, *CE3K* stands apart from others of its genrè and, perhaps significantly, has inspired few imitators and spin-offs.

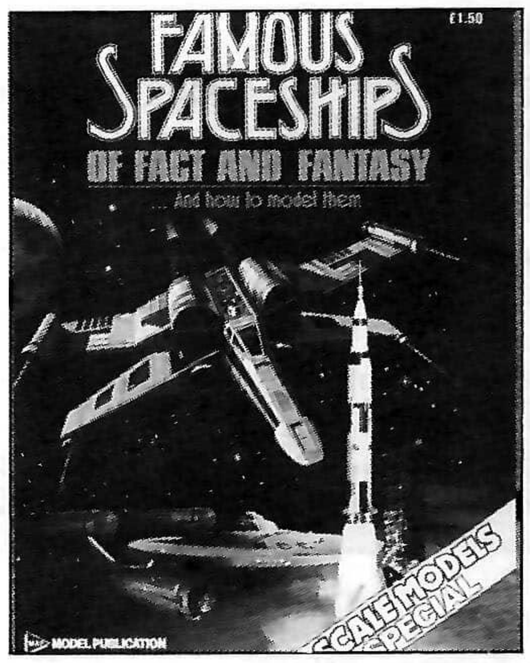
As might be anticipated, there are scores of super quality stills from the film, along with a small selection of preproduction paintings, and many quotations from those involved in the production and moved in some way by the results. As might be expected, the quality of plate production is first rate and one can applaud Ballantine for their graphics and presentation. Although it's difficult for any book, however lavish, to convey the magic of a film like *CE3K,* this one comes close. Interesting asides include a selection of promotional posters which were never used, candid snaps taken during production, and a few story boards that were put onto film but failed to see either version. The title may not be available in the UK now but interested readers could try to contact the publishers direct at Suite 2406, Power and Light Building, Kansas City, MO. 64105, USA. **RLR**

'Giger's Alien' by H R Giger. Published by Big O Publishing Ltd., 228 Fulham Road, London SW10 9NB at around £7.80. Soft covers.

Now that *Alien* is slated for ITV release later this year (allegedly with some attention from the censors) it may be appropriate to review this record of Giger's monstrous creations. One of this movie's greatest attributes was that the hardware and effects took second place to the story in direct contrast to *Star Trek* where the SFX dominated the entire production at the expense of the characters. Creation of the alien in its four basic forms is revealed in the colourful pages of this book as well as including some other products of the Swiss designer's vivid imagination. There is a great deal taken up with the derelict spaceship and its interior, the egg silo and the eerie space pilot locked forever in his circular cockpit; construction of this masterpiece is graphically illustrated and some of the problems inherent in its assembly are explained thoroughly. To many, however, it is the design of the

eggs, face hugger, chest burster and 'Alien III' which will fascinate the most. As one might expect, the evolution of these stages went through many changes and some are illustrated. Notably, the mechanics of the adult alien head posed a tremendous challenge for Carlo Rambaldi, who had previously been responsible for a much more appealing space entity in *CE3K*. With the aid of many superb stills and production pictures, interpolated with Giger's own narrative, the book reveals a most interesting background into the trials and tribulations of bringing this shocker onto the cinema screens.

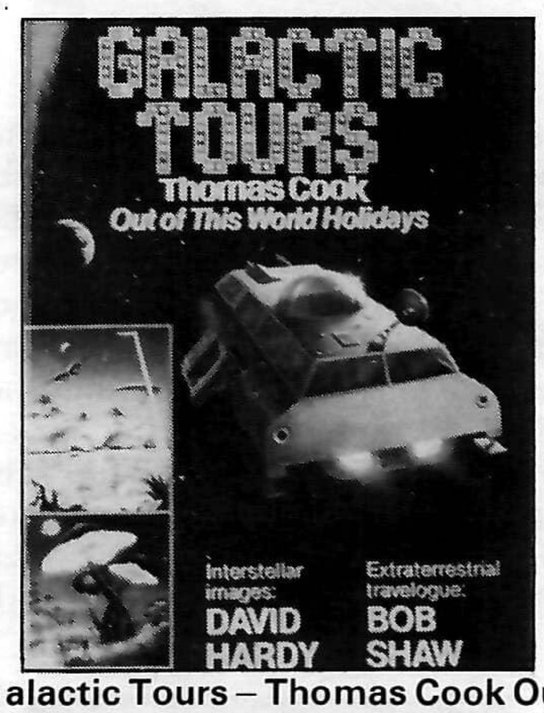
One surprise was the inclusion of the cocoon scene which was actually filmed but scrapped almost at the last minute. The results of the design team's efforts would have added much to the impact of the film but according to Giger this scene was axed so that it wouldn't interrupt 'the steadily mounting tension' of the climactic footage. Of all the many publications that were spawned as a result of the film, 'Giger's Alien' remains, in this reviewer's opinion, the finest and most evocative record. **RLR**



'Famous Spaceships of Fact and Fantasy . . . and how to model them' edited by Harold A. Edmonson. Published in the UK by Model and Allied Publications at £1.50. Soft covers.

Last year's SCALE MODELS special reprint from the Kalmbach original was one of the fastest selling one-shots ever released by MAP onto the UK market. This superlative title covers an extremely broad field of modelling prototypes including a Saturn V, Apollo LEM, 747 and Shuttle Orbiter and SF types like the *X-Wing, TIE Fighter,* Eagles from *Space 1999,* Orion III, the old **AMT** *Enterprise, Viper* and *Cylon Raider* from *Battlestar Galactica* and the original *El Dorado*. Over 90 pages are packed full of colour plates, black and white photos, sketches and diagrams supporting the lively and informative text.

Indeed, as a complete modelling course, this title could hardly be bettered with a beginner's guide to plastic modelling, painting, super-detailing, converting and decalling. The narrative is supported by photos of the actual spacecraft where it exists and photos of the original movie model where it doesn't. Despite the popularity of the title, there are still a few copies available if you missed it first time around. In case of difficulty, these can be supplied at £1.75 each (postage included) from MAP Ltd., PO Box 35, Bridge Street, Hemel Hempstead, Herts. HP1 1EE. **RLR**



'Galactic Tours – Thomas Cook Out of this World Holidays' by David A Hardy and Bob Shaw. Published by Proteus Books at £4.95. Soft covers.

Forget Majorca this year, how about a vacation on the Planet Mycettia where telepathic toadstools conveniently light your path whenever you pass near them? This is just one stop-over in a full colour brochure, thinly disguised as a book, from top astronomical artist Dave Hardy and top SF writer Bob Shaw. The duo have got together to produce a guide to possible holidays Thomas Cook might just provide in a few years', or centurys', time.

David's paintings are reproduced in full colour (other examples are in this issue), with Bob providing typical travel-agent blurb as accompaniment. Do you know, for example, that in the Hotel Ylla on Mars you can, for a slight extra charge, order the Little Green Martian baby-sitting robot to take care of the offspring while you go and view that ungainly and ancient space probe Viking 1, now protected under its energy dome? Or on the edge of the Solar System, in the Hotel Outer Limits on Pluto, every room is equipped with a portable mini-sun globe, just in case you should miss the real one now reduced to a brilliant speck in the sky?

Leave our Solar System and views become even more remarkable, Ocean Planet, Metal Planet and the Dragons of Primeva . . . Overall, an entertaining book, with excellent artwork and witty text. **MI**

'The Illustrated Encyclopedia of Space Technology,' Principal author: Kenneth Gatland, Forword by Arthur C Clarke. Published by Salamander Books at £11.95. Hard covers.

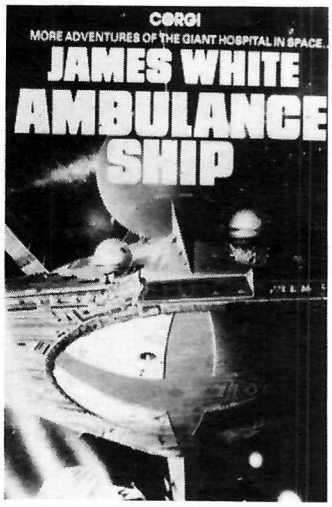
An excellent book for anyone even remotely interested in the hardware of the space industry. It is principally authored by Ken Gatland, long-time astronautical writer who has such credits to his name as a past President of the British Interplanetary Society, editor of the BIS magazine *Spaceflight* and author of a number of books. This publication traces the development of modern astronautics from the end of the last century through the Second World War to present day machinery and into the far future. The illustrations are lavish with full colour cutaway drawings of, for example, the Lunar Rover, the Lunar Module, *Skylab, Salyut* and the Shuttle. One of two fold-out sections features all the principal launch rockets, in scale, including the Soviet D-type launcher which definitely exists, (although no photographs have even been released) and even the semi-mythical giant G-Type launcher, the size of a Saturn 5. The smallest rocket illustrated is the tiny Black Arrow on which Britain's membership of the exclusive club of countries who have launched their own satellites with their own rockets relies.

After the Shuttle, chapters deal with subjects for the near future – factories and colonies in space; manned missions to Mars and orbiting solar power stations. The final chapter takes a speculative look at starships, featuring the BIS's *Project Daedalus,* and subject of an article which can be found elsewhere in this magazine penned by the same author, Alan Bond. In all a terrific book and highly recommended. **MI**

READ OUT

'Dragondrums', by Anne McCaffrey. Published by Corgi at £1.25. Soft covers.

This is the sixth of Anne's books to be set on Pern, the world where dragons are big enough to carry a human rider and the chief threat is from spores that fall from space and carry death to all living things. She is one of the few writers who can tell us of events happening to different people in different places at the same time, and she uses this gift to the full in her 'Dragon' books. This one, concentrating on Piemur, also ranges over both continents and most of the people that we've met before. Do read the other five books in the series before this one or you may get confused; a definite must for all dragon and McCaffrey addicts. **MV**



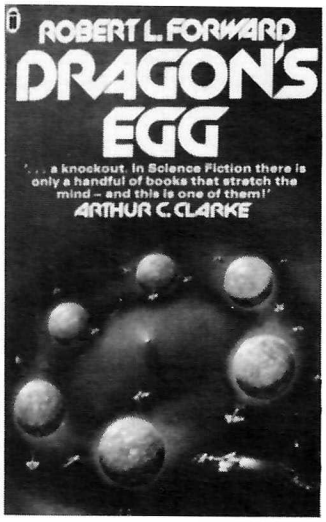
'Ambulance Ship', by James White. Published by Corgi at £1.25. Soft covers.

A continuation of White's 'Sector General' series. 'Sector General' is a multi-species hospital, set in space, and this book covers their new ambulance service. All the old favourites, human Dr Conway and insectile-winged empath Dr Prilicla, six-legged Tralthan Chief Pathologist Thornnastor, and a host of other juicy extra-terrestials. I would not say that this book was quite up to the standard of some of the earlier stories, but it is very good by any other standards and you need not have read the previous stories to understand this one. **MV**

'The Ringworld Engineers', by Larry Niven. Published by Futura at £1.50. Soft covers.

This is the book he vowed he could never write – the sequel to *Ringworld.* It's not quite so simple as that, but then Larry Niven's books never are. I would advise you to read not only *Ringworld,* but *Protector* too, before you tackle this, then

take a deep breath and dive in. I admired *Ringworld* immensely; in fact my personal opinion of it was that it was the *best* book of the 1970s. Does *Engineers* measure up to it? Frankly, no, but what could? Louis Wu is back again, we meet the Hindmost of the Puppeteers, our old kziniti friend and Teela Brown. Larry Niven contrives to write in his usual convoluted and action-packed style but I found it a little depressing. Perhaps, like Louis Wu, he can't find anything new . . . **MV**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'. . . a knockout. In Science Fiction there is only a handful of books that stretch the mind – and this is one of them!'
ARTHUR C. CLARKE

'Dragon's Egg', by Robert L Forward. Published by NEL at £1.50. Soft covers.

On the other hand, this is a one-off, and an original one. The back cover has words of praise by Larry Niven, Hal Clement, Isaac Asimov and Frank Herbert so what else can I do but agree with them?

The story is simple – a neutron star is inhabited by an intelligent life form which starts out far inferior to Earth civilisation but, helped by radio from Earth and its own quick life span, in the end becomes far superior. It is not an original idea, Philip High has covered it, for one, but it is well done and the aliens are lovingly depicted. **MV**

'Paratime', by H Beam Piper. Published by ACE at £1.65. Soft covers.

A collection of the Paratime Police stories by the much-mourned Master of parallel worlds. Many of you will have read his *Paratime* novel, either as *Gunpowder God* or as *Lord Kalvin of Other.* This book contains the other stories of the Paratime Police, and one other (probably his best ever short) *He Walked Around the Horses.,* the tale of the English diplomat that disappeared during the Napoleonic War. For unlucky readers that have never heard of the Paratime Police, this civilisation has access to other worlds and times adjacent to their own, and the Police have the unpleasant task of trying to stop all illegal trafficking. This is an American publication, but has been imported by a British company and seems to be fairly readily available. **MV**

SHORT LOOKS

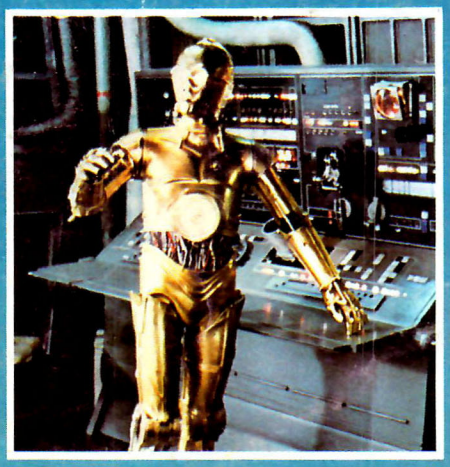
'Master Of The Five Magics' by Lyndon Hardy, published by Futura at £1.50. Unusual and original fantasy – recommended.

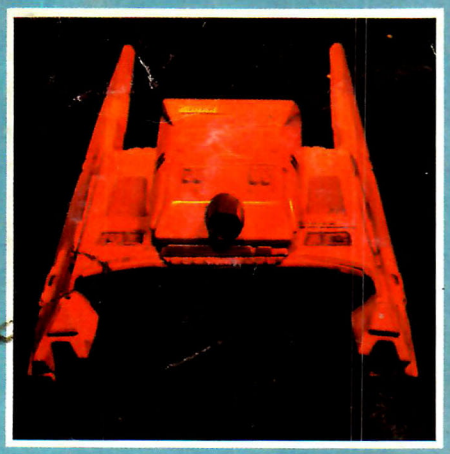
'Blakes' Seven' – Scorpio Attack' by Trevor Hoyle, published by BBC Publications at £1.50. A resumè of the present series' first few episodes. A must for fans.

'The Rose' by Charles L Harness, a re-issue by Granada at £1.25. Contains that legendary novelette based on Hans Anderson's fairytale, *The Nightingale and the Rose* plus two other shorts. Old fashioned maybe, but still haunting.

'The Entropy Effect' by Vonda N McIntire, published by Futura at £1.25. The latest UK *Star Trek* novel. Many fans have written in a role on the *Enterprise* for themselves and I see no reason why a professional writer shouldn't either. Kirk is dead, the Universe disintegrating and only Spock can save them – now where have I heard that before? An above average ST novel, but still below Trekkies' intelligence to judge by some of the fan fiction around today. **MV**

REVIEWING BOOKS FOR THIS ISSUE WERE:
MAT IRVINE (MI), MARIAN VAN DER VOORT (MV), FROM 'AT THE SIGN OF THE DRAGON', AND RAY RIMELL (RLR).





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